Metal Finishing

POLISHING AND BUFFING · BARREL FINISHING · CLEANING
PLATING · ANODIZING · RUST PROOFING · LACQUERING & ENAMELING

MARCH, 1961

CONTENTS:

The Corrosion Protection of Magnesium in Electronic Equipment
Metallic and Organic Finishes

Determining Cloth Content of Bias Buffs
Measure of Quality and Value

Cycling Trends in Decorative Finishes are Turning Back to the Originals
Hammers, Metallics, Wrinkles, and Pearl

Synthetic Resins
Epoxy Resins

Improving Convair's Finishes
Testing Coatings for Aircraft

Current-Distribution Improving Aids
Shields, Robbers, and Bipolar Conductors

Science for Electroplaters
Nickel Plating — Watts Bath

Complete Contents Page 37

Read and pass on—

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PLATING POWER BY DC POWER SPECIALISTS

Mathematical Design from Scripta Mathematica

SERVICE

is a big word at RAPID ELECTRIC

Whether it's technical advice or fast delivery RAPID'S entire organization is at your service.

That's why when it comes to rectifiers and their controls, it becomes a force of habit to call on the local sales distributor selling RAPID.

Similar to calling a medical specialist when a problem arises, more and more of the platers look to RAPID, a specialist in power rectification and controls for over fourteen years. They know that RAPID devotes *all* its resources, finances and technical skill to the design, development and manufacture of all the major components that go into a RAPID rectifier. With this operating procedure it's not difficult to understand why the industry turns to RAPID for *all* their power requirements.

Why don't *you* consult with your local RAPID distributor? (Name available upon request.)

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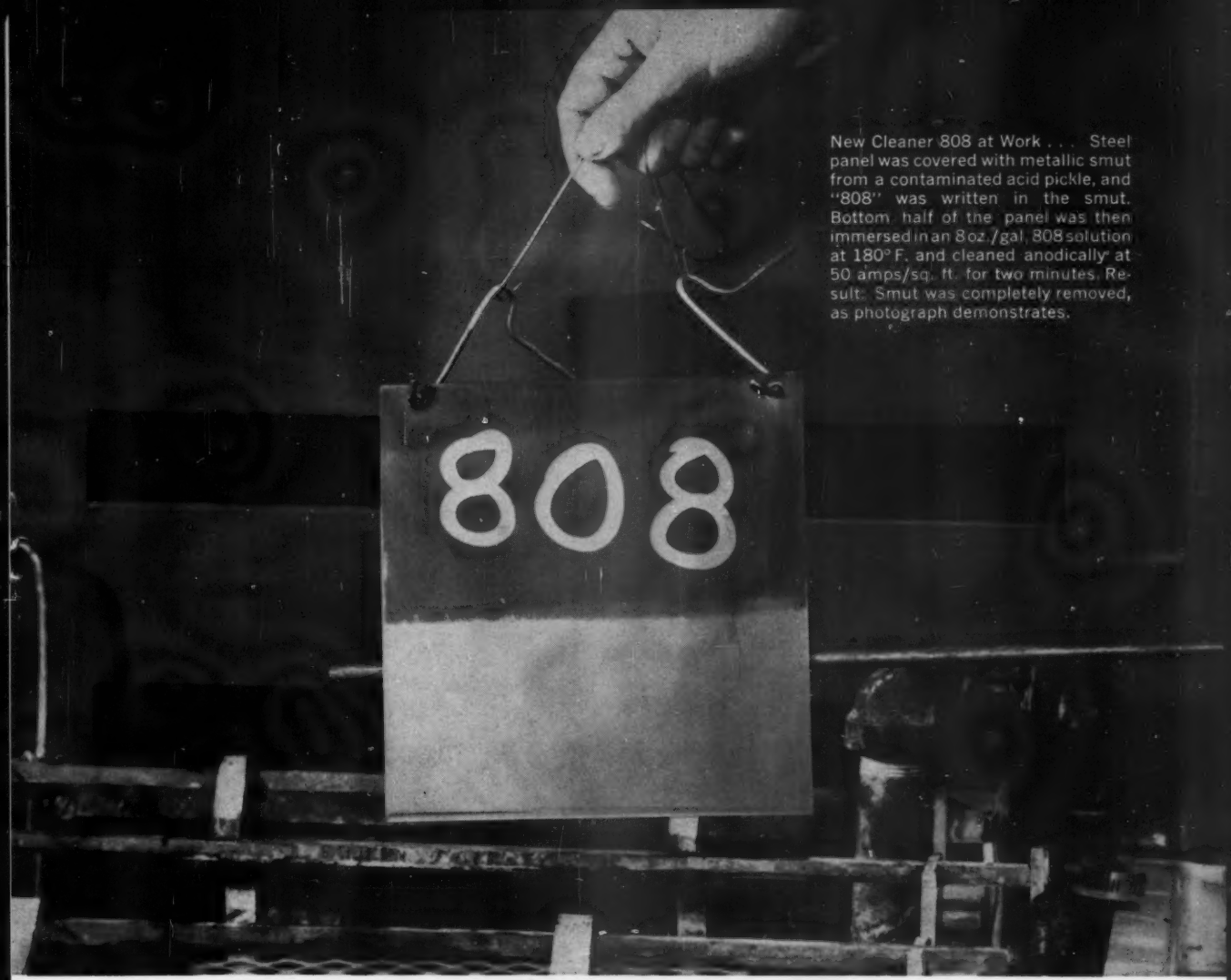
PLANTS: (4) NEW YORK, N.Y. • GRAYSBRIDGE ROAD, BROOKFIELD, CONN.



New Cleaner 808 at Work . . . Steel panel was covered with metallic smut from a contaminated acid pickle, and "808" was written in the smut. Bottom half of the panel was then immersed in an 8 oz./gal. 808 solution at 180° F. and cleaned anodically at 50 amps/sq. ft. for two minutes. Result: Smut was completely removed, as photograph demonstrates.

For Steel . . . **NEW CHELATING ELECTRO-CLEANER**
Removes Light Rust, Scale, Smut, Oxides

Cleaner 808, a new development of Enthonics research, is an alkaline electro-cleaner with chelating action. Its selective chelating agents chemically encircle and remove smut, oxides, light scale and rust. Its high-detergency, high-conductivity ingredients complete the cleaning job. Result: Bright surfaces completely free of contamination.

Cleaner 808 is excellent for anodic cleaning of steel which has just enough rust or scale to defy conventional electro-cleaners. In most applications, by using the work as an anode at current densities of 50-75 amps/sq. ft., cleaning time is 1 to 5 minutes.

Cleaner 808 also is being used cathodically. One such application: Cleaning used automobile bumpers for replating.

Cleaner 808 is a dustless, free-flowing alkaline powder with superior wetting, penetrating and dispersing characteristics, and water softening action. A low foam blanket minimizes spray and hydrogen gas explosion. Because oils are displaced and float to the surface, the cleaning solution is free of contamination, has long life.

For complete information about Cleaner 808 with chelating action, write to Enthone, Inc., 442 Elm Street, New Haven 8, Conn.

ASARCO

ANOTHER PRODUCT OF *Enthonics* RESEARCH

ENTHONE

A Subsidiary of American Smelting and Refining Company

For a pre-cleaning short-cut to better plating

ask Oakite

OVER 50 YEARS CLEANING EXPERIENCE • OVER 250 FIELD SERVICE MEN • OVER 160 MATERIALS

Now—remove smut, rust and soils with one electrocleaner: Oakite 190

Here is a new reverse-current cleaner that performs two operations at once. (1) It removes the oily soils normally requiring an alkaline cleaner . . . and (2) it removes smut and rust bloom normally requiring additional treatment.

New Oakite 190 performs this double duty because it's a *chelated* detergent. Chelation—which makes metallic salts and oxides soluble in water—handles the removal of smut, heat scale and rust. Powerful alkaline detergency handles the removal of oil films and shop soil. As a bonus, Oakite 190 has high conductivity, rinses well in hot or cold water.

Result: new Oakite 190 insures fewer plating rejects due to inadequate pre-cleaning, *eliminates an entire operating step* in many instances.

For more details about Oakite 190, ask your local Oakite man or write to Oakite Products, Inc., 26 Rector Street, New York 6, N. Y.

it PAYS to ask Oakite

OAKITE

over 50 Est. 1909 SCIENCE

years' leadership in industrial cleaning

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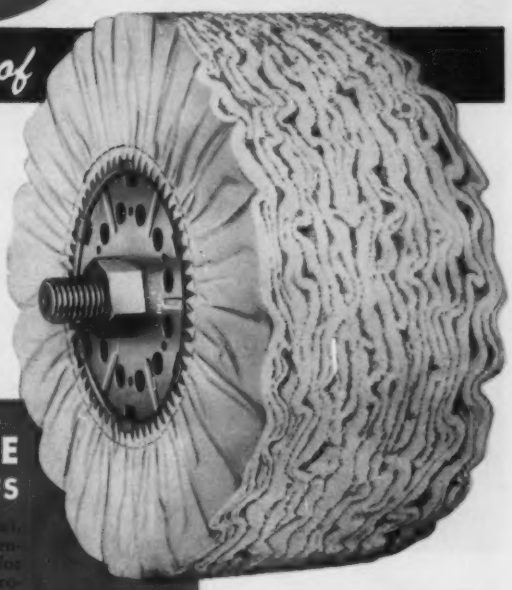

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Spotlights on standards...

the four American Presidents, carved out of the mountainsides, set standards which contemporary "public servants" might well emulate. This scene is particularly awe-inspiring at dusk, spotlighted by Crouse-Hinds, manufacturers of industry's standards in special purpose lighting, explosion-proof electrical equipment enclosures, traffic control equipment, and world-famous condulets.

30 YEAR OLD MEAKER "AUTOMATIC" PLATES 65-70 TONS OF PRODUCTS EVERY EIGHT HOURS AT CROUSE-HINDS CO.

In operation for over 30 years, the MEAKER AUTOMATIC at Crouse-Hinds, Syracuse, New York, turns out 65-70 tons of zinc plated condulets every eight hours. What's more, no down time has been recorded in all these years as the fault of the machine.

Reports Mr. Floyd Quinn, Plating Foreman: "Our MEAKER was installed in 1929 to handle condulets up to ¾" diameter. We have been processing from ⅜" *up to 6" diameters for years,* with no modification to the equipment." That's versatility!

No wonder Mr. Quinn adds: "If we were to install another automatic plater tomorrow, we'd insist on a MEAKER with little change from the one we have."

MEAKER has been building automatic processing equipment for continuous or batch type metal finishing since 1899 . . . from "compact-a-matic" units occupying minimum floor space and for limited production requirements—to the world's largest automatic plating installation which occupies over 180,000 square feet and produces 4½ acres of plated surface every 16 hours.

Our catalog "WHEN TO AUTOMATE" will give you some valuable ideas for improving. profits through automatic plating or metal finishing

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7⅜"

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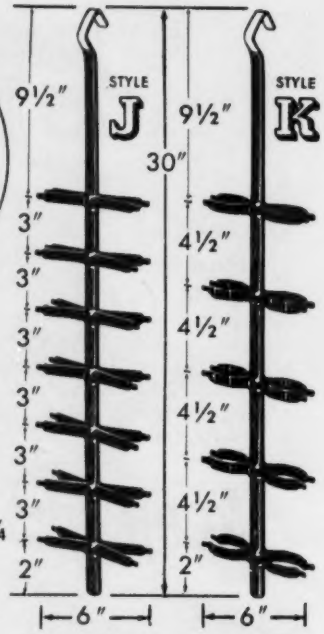

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36" lengths available

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Straight .093 dia. phosphor bronze wires; 8" long, 1½" centers. Wires easily shaped or shortened.

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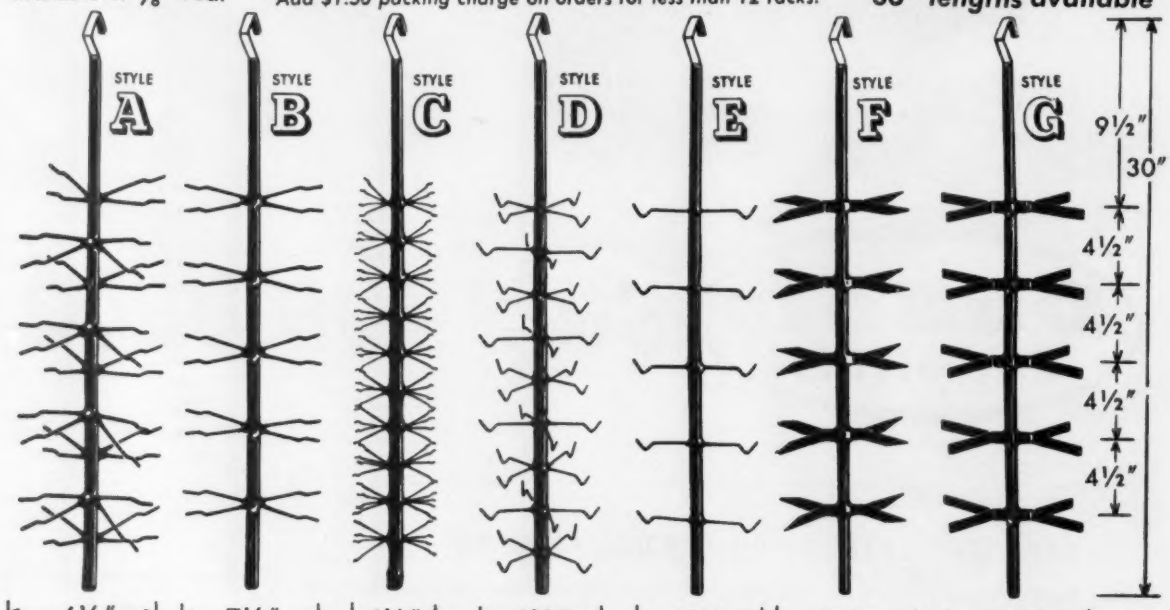

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Tips 1/16" dia. **$6.00**

Tips 3/32" dia. **$5.83**

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2 OPERATIONS SAVED.
On base of small waffle iron, 1 cut-down operation, and 1 hand coloring operation have been eliminated through the use of Superlume.

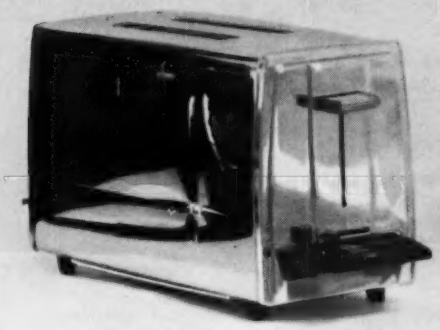
1 OPERATION SAVED.
On base of large waffle iron, 1 coloring operation is no longer necessary.

3 OPERATIONS SAVED.
On round toaster shell, 1 cut-down operation and 2 coloring operations have been eliminated.

1 OPERATION SAVED.
On the steam iron shoe, 1 hand coloring operation has been eliminated.

yet SUPERLUME vastly improves all 5 of these Son Chief products ...and at no extra cost.

says NICHOLAS J. LAZZARO, JR.
Asst. Plant Superintendent
in Charge of Finishing,
Son Chief Electrics, Inc.,
Winstead, Connecticut



Son Chief Electrics, Inc., appliance makers, sought a thicker, brighter plate, more rapidly applied. They found it in Superlume—along with major reductions in finishing operations, plus what Nick Lazzaro calls "Tremendous improvement in our products' appearance... a real breakthrough in quality."

Actually, Son Chief is plating *twice* as thick in the same time as before (using 60 amps per sq. ft. instead of 30).

They're plating flat pieces now and forming *after* plating... a big production advantage unique with highly ductile Superlume.

Superlume bath is easier to maintain. Son Chief's normal operating schedule is 5 days, 16 hours a day. But for two months every year, they work on a *24-hour/5-day basis.* Average pieces per hour through trouble-free Superlume: 336, with a low of 226, a high of 904. Son Chief plates 30 different parts ranging from 1 to 20 inches long. Superlume bath in use: 3100 gallons.

Good-sized operation... healthy benefits... no added production costs. For full facts on Superlume as applied to *your* operation, contact H-VW-M. Chances are you, too, will be better off with this better bright nickel bath.

HIGHER QUALITY FINISH.
On square toaster shell, same finishing operations are required with Superlume, but appearance of product is tremendously improved. On all 5 products, in fact, Superlume has stepped up product quality appreciably—and, in every instance, *at no increase in cost.*

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Progress in metalfinishing through advanced processes • equipment

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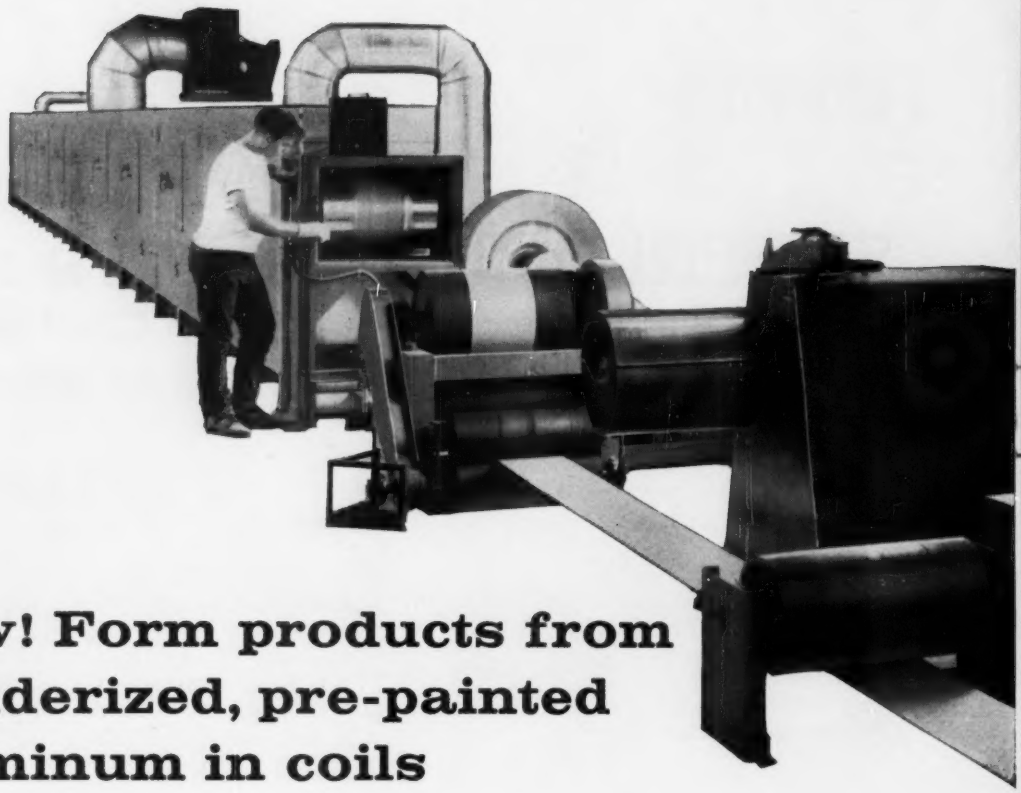
Alert Supply Company is H-VW-M in the West • Los Angeles • San Francisco



Now! Form products from Bonderized, pre-painted aluminum in coils

A modern, new way to better products at lower manufacturing cost. Use Bonderized aluminum coil stock with baked-on paint, ready for fabricating.

Automated straight-line production assures uniform Bonderized and roll coat painted coil meeting the highest quality control standards.

The Bonderite coating on aluminum stock accomplishes the double job of controlling corrosion and anchoring the paint. Paint adhesion is so spectacular that the most severe forming operations can be accomplished without finish failure.

Service life of paint over Bonderized aluminum is five to ten times that on untreated aluminum!

Improve manufacturing efficiency, product performance and customer satisfaction by forming your aluminum products from Bonderized, pre-painted coil stock. The Parker representative has complete, helpful information for you.

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BONDERITE corrosion resistant paint base

BONDERITE and BONDERLUBE aids in cold forming of metals

PARCO COMPOUND rust resistant

PARCO LUBRITE—wear resistant for friction surface

**Bonderite, Bonderized, Bonderlube, Parco, Parco Lubrite—Reg. U.S. Pat. Off.*

Photo courtesy KEYSTONE ALLOYS COMPANY

Company

TROPICAL—heavy duty maintenance paints since 1883

Now Ready For Distribution

METALLIZING OF PLASTICS

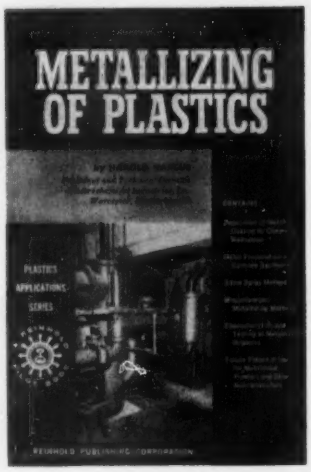
by **HAROLD NARCUS**

President and Technical Director, Electrochemical Industries, Inc.

1960, 208 pages, 55 illustrations, $5.50

COVERS DETAILS OF EVERY COMMERCIAL PROCESS

THIS EAGERLY AWAITED BOOK presents complete details for carrying out every commercial metallizing process for plastics or other nonconductors. It is the first treatment of the subject that deals with *actual production procedures, formulations* and *techniques* for all known metallizing methods. These include the copper film process (developed by the author), the deposition of "electroless" nickel coatings, a review of the new molded conductive plastics, "gas" plating, the deposition of thick evaporated films and many, many others. The text is replete with illustrations showing the latest equipment being used in the newer processes. Recent advances receive special attention, particularly in the final chapter. This chapter contains developments as recent as a few months ago.



Much more than a bibliographic source, this book is essentially a metallizing manual for the plastics, electronics and electroplating industries.

CONTENTS

Deposition of Metallic Coatings by Chemical Reduction • Vacuum Metallizing • Cathode Sputtering Process • Silver Spray Method • Miscellaneous Metallizing Methods • Characteristics and Testing of Metallized Deposits • Future Potential Uses for Metallized Plastics and Other Nonconductors • Bibliography • Index

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All equipment is custom-designed to exacting specifications with the famous Singleton fusion-welded construction. For the highest quality at the most reasonable prices and fastest service, contact your nearest distributor or The Singleton Company direct.

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President

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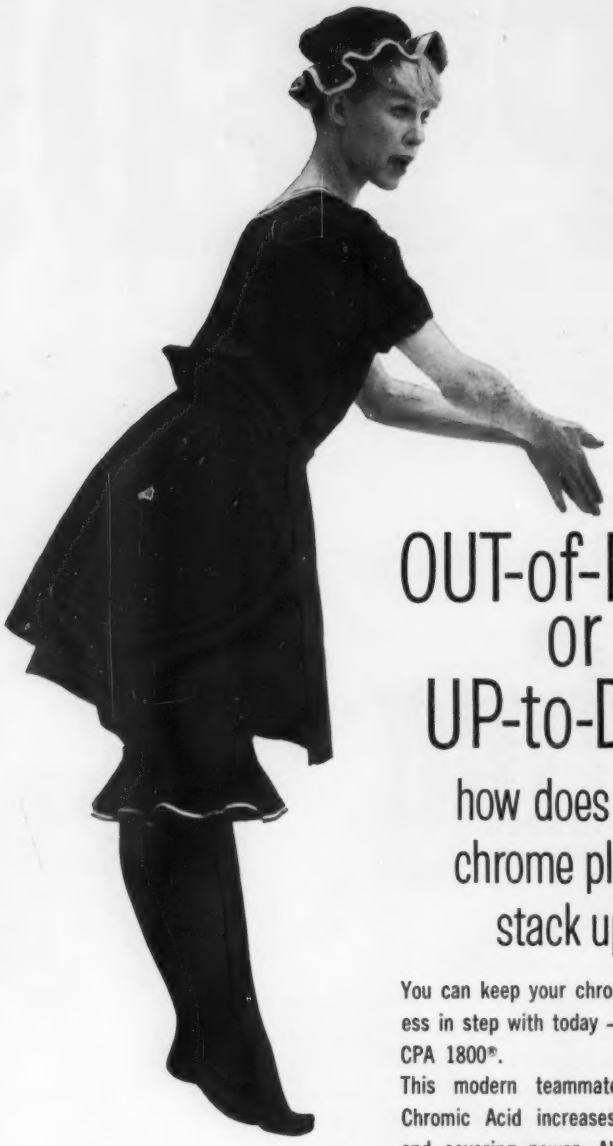


OUT-of-DATE or UP-to-DATE

how does your chrome plating stack up?

You can keep your chrome-plating process in step with today — with Diamond CPA 1800®.

This modern teammate for Diamond Chromic Acid increases plating speed and covering power. Allows a broader operating range. Simplifies anoding and produces a brighter, harder coating. Improves the metallurgical characteristics of chromium plate.

In short: Diamond CPA 1800 cuts your unit costs and saves you money. Diamond developed it. Your Diamond CPA 1800 Distributor can supply it where and when you need it.

For further information — call or write Diamond Alkali Company, 300 Union Commerce Building, Cleveland 14, Ohio.

Diamond Chemicals

Curved anodes fit the curve of the current-carrying saddle, parallel the surface of the cylinder being plated.

CURVED TO FIT THE SADDLE, ANACONDA "PLUS-4" COPPER ANODES PLATE SMOOTHER – CUT COSTS

Anaconda "Plus-4" Curved Anodes are 1" thick, 3" across inside surface. You simply specify the inside radius of the anode, to fit your tank. There is no extra die cost.

At Pulitzer Publishing Co., St. Louis, Mo., Anaconda "Plus-4" (phosphorized copper) Curved Anodes have been doing a superior job of plating cylinders. Mr. Jack Snyder of the Rotogravure Section says:

"Curved design lets anodes at top of saddle holder slide together by gravity, eliminating submerged arcing.

"Curved design gives better contact–saves electric power.

"Phosphorized anodes corrode very uniformly. There's less scrap.

"Copper build-up in solution has been greatly reduced by phosphorized anodes. Sludging is minimum.

"'Plus-4' plated cylinders have a smoother finish."

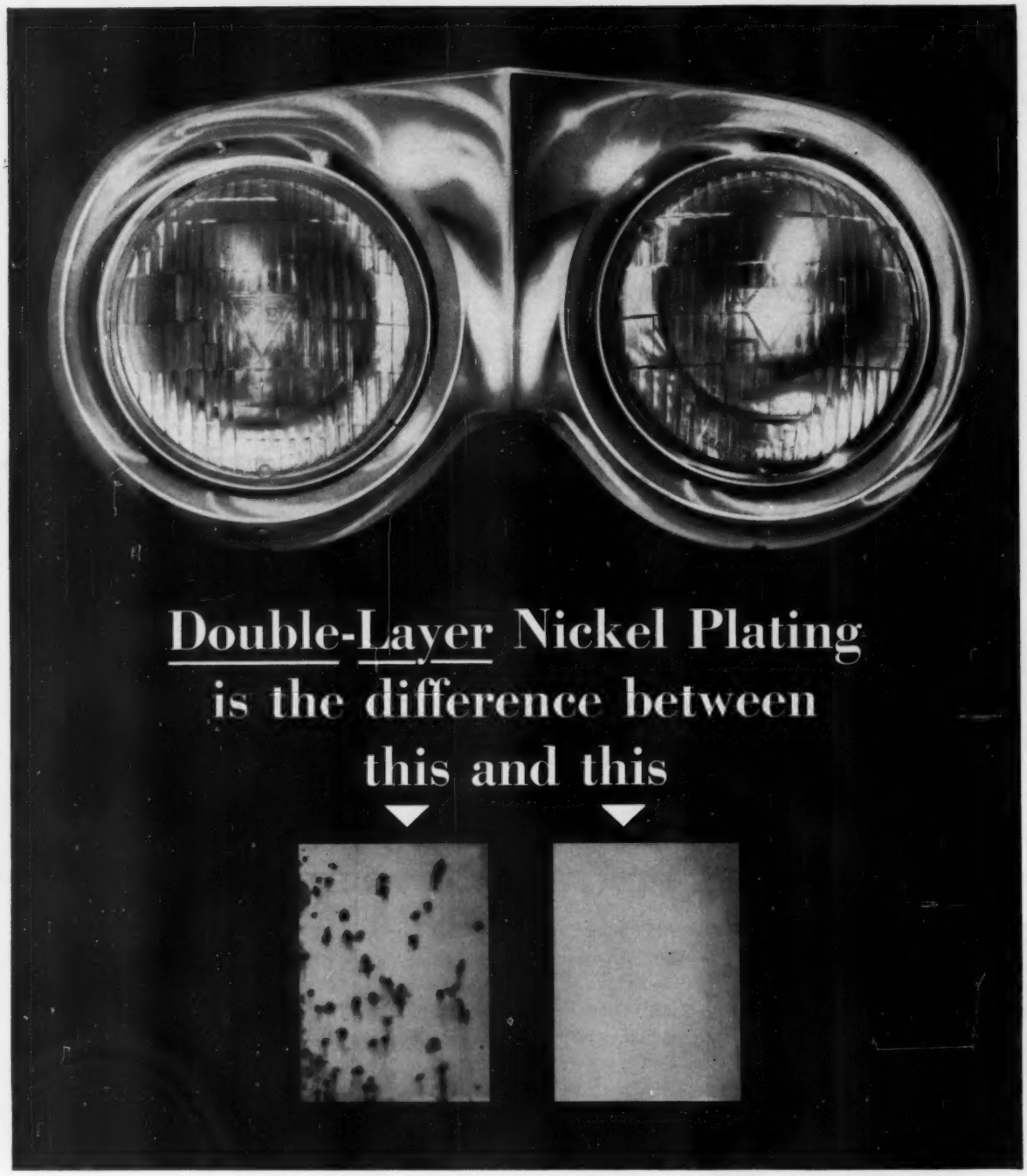
Similar reports are coming in from users all over the country. You can start profiting from these advantages in your own plant by calling your Anaconda representative – or write: Anaconda American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ont.

"PLUS-4"® PHOSPHORIZED COPPER ANODES

ANACONDA®

products of

Anaconda American Brass Company



Double-Layer Nickel Plating is the difference between this and this

Both of these plated panels were exposed in a corrosive marine atmosphere for 18 months!

You can see how the panel on the left — plated with a Nickel-Chromium coating that is perfectly suitable for less rugged use — fared in this severe outdoor test.

But the panel on the right — *coated to the same 2.0 mil thickness* — retained its rich original luster!

Why? *Double-Layer* Nickel Plating — a good thick layer of sulfur-free, semi-bright Nickel beneath the lustrous bright Nickel layer and the thin chromium overlay.

Remarkably durable, this combination provides outstanding resistance to corrosion, abrasion and wear . . . helps assure the mirror-bright, *lasting* eye appeal that satisfies today's quality-conscious customers.

For more information on the durability of decorative Nickel-Chromium plating, write for your free copy of "*The Contribution of Nickel and of Chromium to the Durability of Decorative Plating.*"

The International Nickel Company, Inc.
67 Wall Street New York 5, N.Y.

Inco Nickel

Nickel makes plating perform better longer

LEA

ABRASIVE FINISHING METHODS

BRASS and BRONZE

STAMPINGS • CASTINGS • FORGINGS • SPINNINGS • DIE CASTINGS

In the finishing of brass (and bronze) a wide variety of effects can be obtained with LEA COMPOUND, ranging from non-reflective brush brass or satin finishes to almost a high lustre finish. Results depend on the grade of LEA COMPOUND, the type of wheel and the surface speed of the wheel. In general, the coarser grades of LEA COMPOUND, such as Grades "C", "B" and "L", produce the duller type of finish. Soft-faced wheels and low-surface speeds produce duller finishes than when the same grade of LEA COMPOUND is used on a more rigid type wheel or at a higher surface speed.

LEA COMPOUND is used to good advantage for replacing set-up wheels in the finer numbers where set-up wheel operations (180 to 240) are necessary on castings, forgings, die cast brass, etc. When LEA COMPOUND is used on a resilient wheel, brass shows practically no tendency to drag.

For high-lustre buffing on brass and its alloys where contours and ornamentations tend to pack up with the ordinary buffing compositions, a suitable grade of LEAROK, the buffing bar with no free-grease or LEA LIQUABRADE, liquid buffing composition, should be used.

POLISHING...Recommended polishing speeds for brass with conventional wheels are around 7000 sfm. Grade "B" LEA COMPOUND is frequently used at 6000 sfm for polishing brass with sewed buffs, canvas, felt or solid leather polishing wheels. With rigid wheels and heavy LEA COMPOUND heads, the use of Grade 155 LEAROK or LEA LUBAR is recommended as a lubricant.

INTERMEDIATE FLEXIBLE POLISHING . . . Where small defects, flash, etc., are to be removed, use LEA COMPOUND (such as Grade "B-31" or "C") on sewed buffs or loose muslin sections at 5500 sfm.

SATIN FINISHING...This is a final finish, produced at surface speeds of 3500 to 5500 sfm with LEA COMPOUND such as Grade "C", "B" or "N" on loose muslin buffs, ventilated or bias buffs, string or wick wheels with or without LEAROK 155 or LUBAR as a lubricant, according to the line-effect desired.

BRIGHT FINISHING (Bar Compositions)...To produce this finish, showing no surface defects, use Grade "B-31" LEA COMPOUND on a loose muslin buff at 3000 to 5000 sfm, followed by Grade 765 or 884 LEAROK on a loose muslin buff at 7000 to 8000 sfm.

BRIGHT FINISHING (Liquid Compositions)...All operations at 7000 to 8000 sfm. LEA LIQUABRADE (liquid abrasive composition) in a suitable grade applied automatically with spray guns gives excellent bright finishes:

Cut—TH52P and TH62M LIQUABRADE
Color—UH20A or 63LR LIQUABRADE
Buff—Ventilated or Loose Muslin

Burring, Buffing, Polishing, Lapping, Plating and Spray Finishing . . . Manufacturers and Specialists in the Development of Production Methods, Equipment and Compositions. Manufacturers of Lea Compound and Learok . . . Industry's quality buffing and polishing compounds for over 30 years.

The Hallmark of Quality Products

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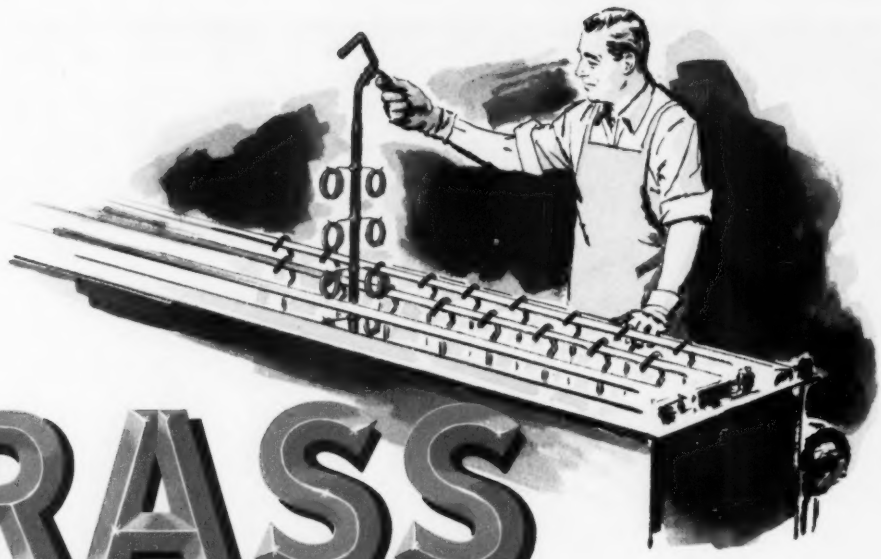
16 CHERRY AVE., WATERBURY 20, CONN.

Lea-Michigan, Inc., 14459 Wildemere Ave., Detroit 38, Mich.
Lea Mfg. Company of Canada, Ltd., 1236 Birchmount Road, Scarborough, Ontario, Canada
Lea Mfg. Company of England, Ltd., Buxton, Derbyshire, England
Lea-Ronal, Inc., Main Office and Laboratory: 139-20 109th Ave., Jamaica 35, N. Y.
Manufacturing Plant: 237 East Aurora St., Waterbury 20, Conn.

Are you interested in plating specialties? SEE THE OTHER SIDE OF THIS INSERT.



BRASS PLATING

3 Tailored Processes for Your Production Needs

Lea-Ronal has developed a **group** of brass plating processes designed to take the guess work out of brass plating. We emphasize the word **group** because experience in and knowledge of perfected processes within a group help greatly in developing others. We now offer three formulae for brass plating, each capable of being 'tailored' to meet each user's operating needs.

BRASS GLO*—high speed brass process for **still tanks** well proved after several years operations in numerous plants. Uniform lustrous deposits over wide range of current densities with high cathode efficiencies.

BRASS GLEAM*—high speed brass process for **barrels.** Uniform brass colored deposits; wide range of current densities at high cathode efficiencies.

BRASS FLASH—new but production proved—an additive for standard low temperature brass solutions where thin flash deposits are plated, for example, over **bright** nickel. Uniform stable color over wider current density range than with conventional brass baths.

If you are in brass plating investigate these three Lea-Ronal processes. Unless you are thoroughly satisfied with end results and costs, why not try the items that fit into your production picture. Give us the details. We'll fit the L-R formulation to your needs.

*Patented and Patents Pending

Lea-Ronal *Inc.*

Sales and Manufacturing Plant: 237 East Aurora Street, Waterbury 20, Conn.
Main office and Laboratory: 139-20 109th Avenue, Jamaica 35, N. Y.

Are you interested in Buffing, Polishing and Burring Specialties? SEE OTHER SIDE OF THIS INSERT.

BIG STEVE

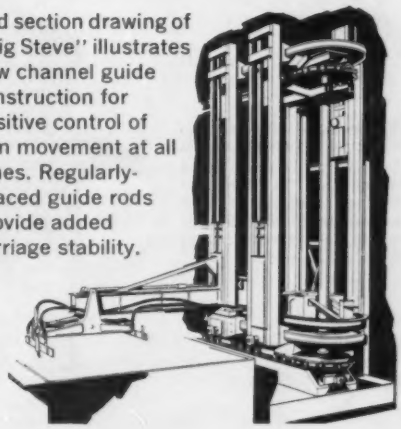
puts more speed and muscle into automotive plating production!

NEW STEVENS RACK MACHINE IS FAST, TAKES HEAVY LOADS IN STRIDE, REQUIRES LITTLE MAINTENANCE!

To do the really big plating job required in a prominent auto manufacturer's plant, this rugged, newly-designed "Big Steve" Automatic Rack Machine was installed and challenged with a heavy production schedule. "Big Steve" proved to be more than a match for the job. Plating speed, as well as load-per-rack, was greatly increased. Schedules were easily met; cost-per-piece was reduced.

"Big Steve" with its rugged, new channel guide and roller-carriage lift mechanism provides absolute control of arm movement during raising, lowering and transfer operations.

Simplicity, construction strength and design versatility . . . plus extremely low maintenance . . . are only a few of the many "Big Steve" features you should investigate. Write for complete information today.



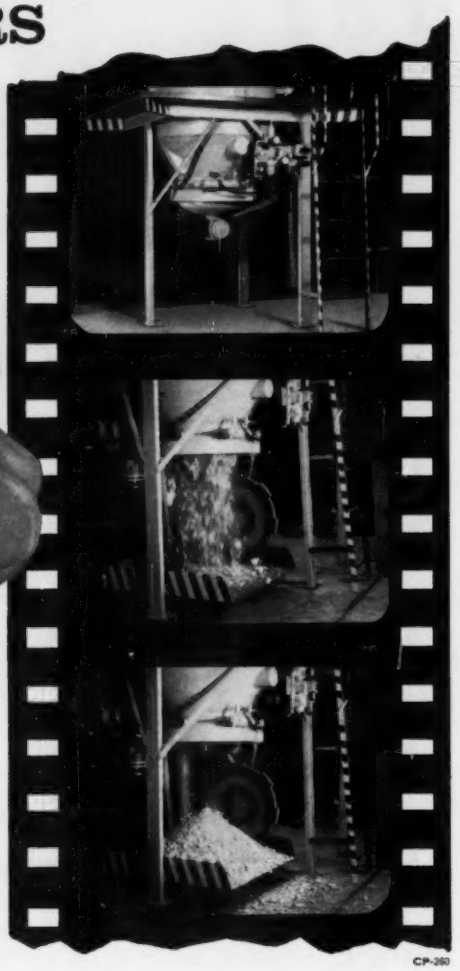
End section drawing of "Big Steve" illustrates new channel guide construction for positive control of arm movement at all times. Regularly-spaced guide rods provide added carriage stability.

frederic b. STEVENS, inc.

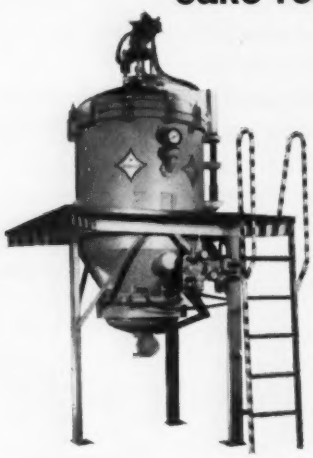
DETROIT 16, MICHIGAN

Buffalo · Chicago · Detroit · Cleveland · Dayton · Wallingford (Conn.) · Indianapolis · Springfield (Ohio)

SAVE TIME and EFFORT WITH MODERN FILTERS



CP-260



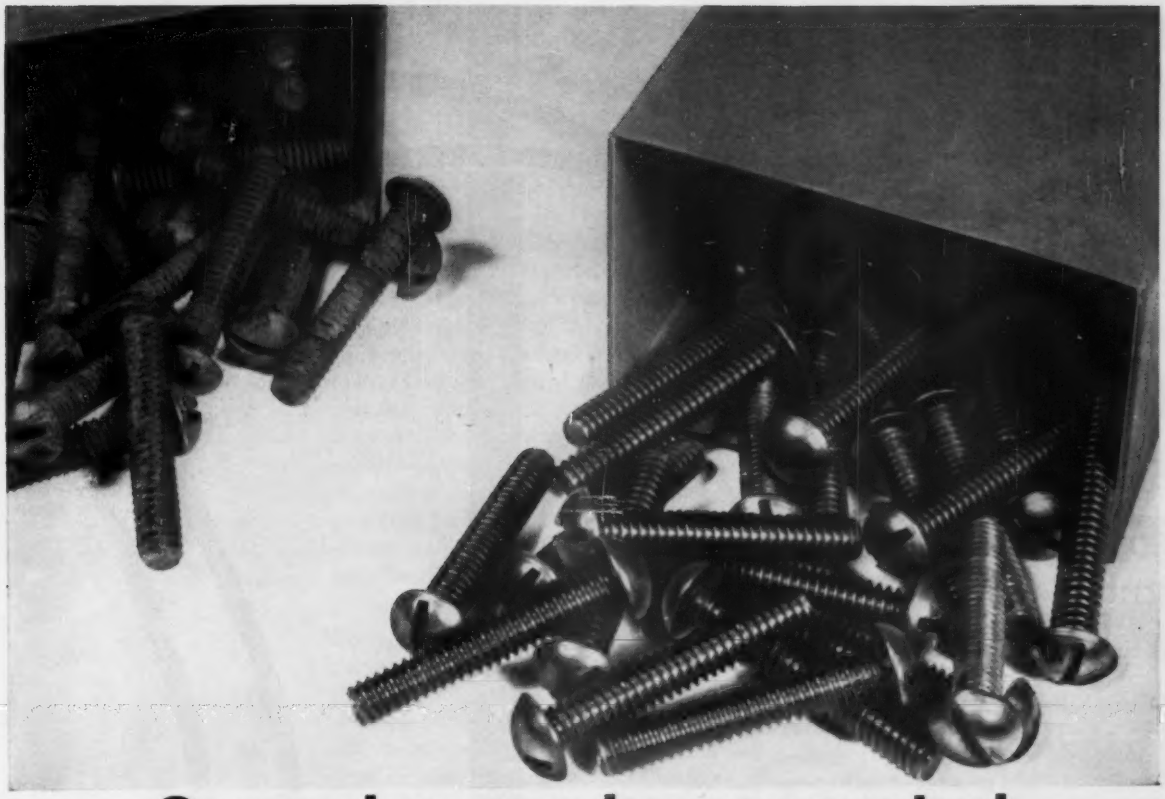
These rapid cleaning devices on INDUSTRIAL filters offer tremendous advantages to the user through removal of, and subsequent disposing of waste materials or recovery of valuable solids.

With VIBRA-SHOC or RECIPRO-SHOC, cleaning of your INDUSTRIAL filter is completed in minutes. The above mentioned trade named devices are obtainable on INDUSTRIAL'S TYPE 152 filters, as are such optional equipment as QUICK OPENING COVERS, LIQUID SHOC and AIR WASH, all designed with the efficiency you require for your particular operation. All these mechanical aids work for you to realize a definite cost savings based on reduced downtime, for either continuous or batch type operation. These self-cleaning devices also eliminate the manual dirty work in handling any dry, wet or semi-solid material.

INDUSTRIAL

INDUSTRIAL FILTER & PUMP MFG. CO.
5906 West Ogden Avenue, Chicago 50, Illinois

PRESSURE FILTERS ♦ ION EXCHANGERS ♦ CORROSION TEST CABINETS ♦ PUMPS ♦ WATER & WASTE-TREATING EQUIPMENT



Corrosion can be prevented with SOLVAY SODIUM NITRITE

Even the finely machined, threaded surfaces of tiny screws can be kept free of rust by treating them with SOLVAY® Sodium Nitrite!

These screws are identical with one important *exception.* The contents of the right-hand box were dipped in a low cost 3 to 5% concentration of SOLVAY Sodium Nitrite to form an invisible gamma oxide protective film that guards metal surfaces against corrosion. This easy treatment works equally well on big metal parts–iron or steel sheets, tubes, bars or semi-finished parts during storage or between processing steps. Spray or dip it on, in solution–add it to circulating water systems–combine it with phosphates for greater moisture resistance. In addition, it is reported to suppress degradation in aluminum, tin, monel, copper and brass.

Get the details about the many anti-corrosion uses of SOLVAY Sodium Nitrite and a test sample...

Sodium Nitrite • Calcium Chloride • Chlorine • Caustic Soda • Caustic Potash Chloroform • Potassium Carbonate • Sodium Bicarbonate • Methyl Chloride Soda Ash • Ammonium Chloride • Methylene Chloride • Monochlorobenzene Vinyl Chloride • Para-dichlorobenzene • Ortho-dichlorobenzene • Ammonium Bicarbonate • Carbon Tetrachloride • Snowflake® Crystals • Hydrogen Peroxide Aluminum Chloride • Cleaning Compounds • Mutual® Chromium Chemicals

Allied Chemical

SOLVAY PROCESS DIVISION
61 Broadway, New York 6, N. Y.

SOLVAY branch offices and dealers are located in major centers from coast to coast.

SOLVAY PROCESS DIVISION 44-31
ALLIED CHEMICAL CORPORATION
61 Broadway, New York 6, N.Y.

Please send me without cost:
- ☐ Test sample of SOLVAY Sodium Nitrite
- ☐ Booklet–"Sodium Nitrite for Rust and Corrosion Prevention"

Name_____
Position_____
Company_____
Phone_____
Address_____
City_____ Zone____ State_____

pH 7

some facts about the first truly neutral, high performance trichlorethylene

Columbia-Southern's improved Trichlor makes your job easier, your cleaning better and your costs lower.

Here are the facts:

Longer life and greater stability—proved by actual operation.
Result: Lower cleaning costs—more metal degreased per pound of Columbia-Southern Trichlor.

Rugged stabilization—helps prevent contaminant break-down.
Result: Lower maintenance costs—less sludge formation and longer operating time between clean-outs.

Alkalinity—closer to neutral than any other degreasing trichlorethylene.
Result: Better control in alkaline sensitive operations.

High acid acceptance—highest average acid acceptance of any commercially available trichlorethylene.
Result: Greater protection against acid contaminants.

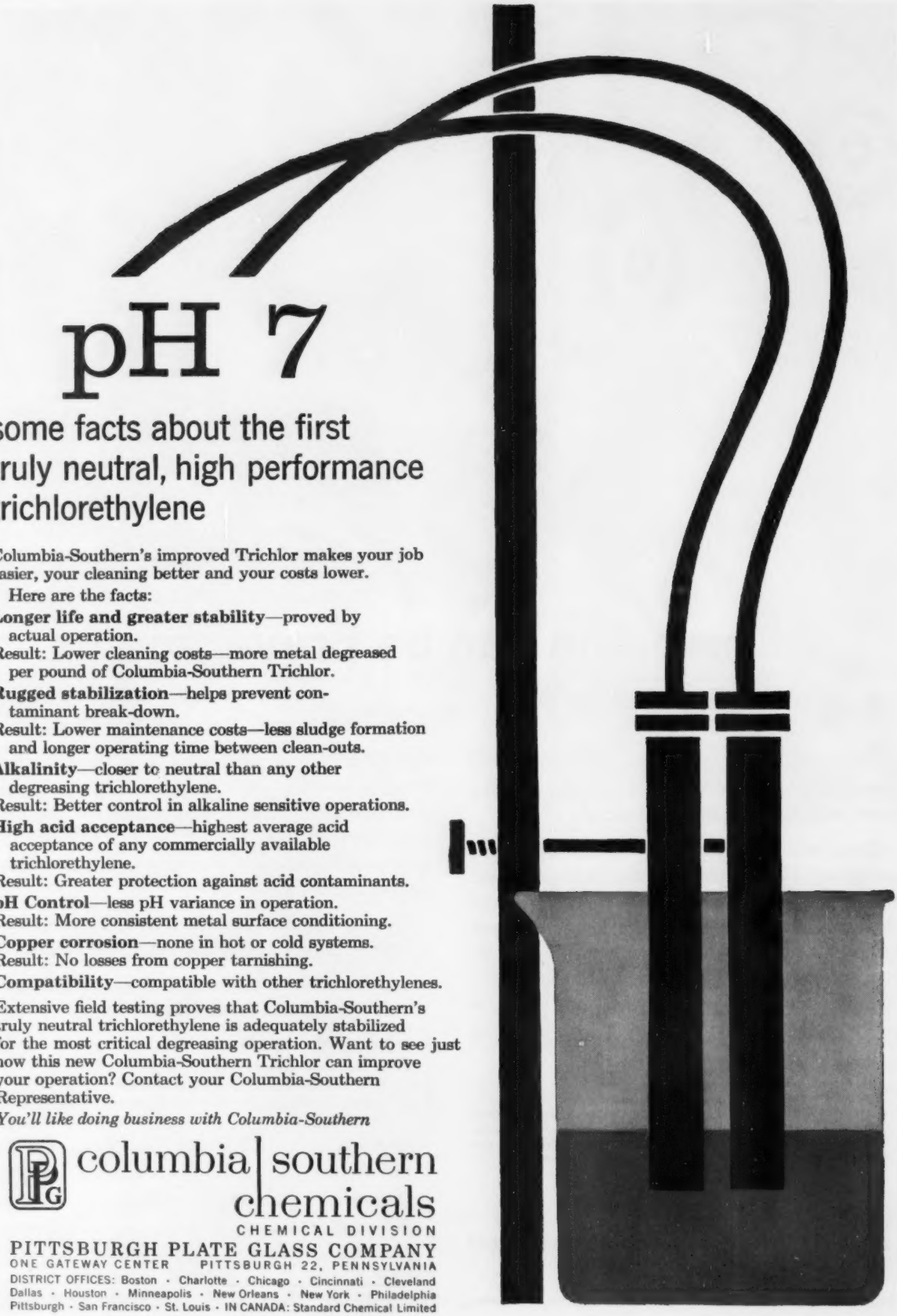
pH Control—less pH variance in operation.
Result: More consistent metal surface conditioning.

Copper corrosion—none in hot or cold systems.
Result: No losses from copper tarnishing.

Compatibility—compatible with other trichlorethylenes.

Extensive field testing proves that Columbia-Southern's truly neutral trichlorethylene is adequately stabilized for the most critical degreasing operation. Want to see just how this new Columbia-Southern Trichlor can improve your operation? Contact your Columbia-Southern Representative.

You'll like doing business with Columbia-Southern



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CHEMICAL DIVISION
PITTSBURGH PLATE GLASS COMPANY
ONE GATEWAY CENTER PITTSBURGH 22, PENNSYLVANIA
DISTRICT OFFICES: Boston · Charlotte · Chicago · Cincinnati · Cleveland Dallas · Houston · Minneapolis · New Orleans · New York · Philadelphia Pittsburgh · San Francisco · St. Louis · IN CANADA: Standard Chemical Limited

LEVELMAX BRIGHT NICKEL

BRIGHT, HARD, SMOOTH FINISHES

on rough, dull, unbuffed surfaces

Levelmax — the bright nickel process — reduces or eliminates surface buffing and polishing, simplifies chrome plating, makes possible bright plating of hard-to-buff areas. You get bright, smooth nickel coatings on poorly polished steel, unbuffed stampings and castings and dull copper plate. Levelmax is simple to control, has high tolerance to organic and metallic contamination, can be used under standard plating conditions. Levelling action is excellent. Levelmax bright nickel takes chrome easily. The Levelmax process is the most versatile of the nickel processes for varied product shapes, base metals and applications.

For complete working details, write on your company letterhead for Bulletin 191, Levelmax operating manual. Write Federated Metals Division, American Smelting and Refining Company, 120 Broadway, New York 5, N. Y., or call your nearest Federated sales office.

ASARCO

Use

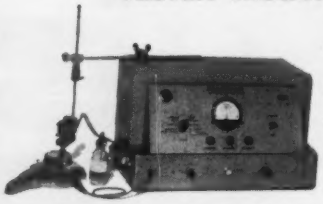
KOCOUR TEST EQUIPMENT

TO SOLVE YOUR

plating thickness problems!

You can depend on the

KOCOUR ELECTRONIC THICKNESS TESTER Model 955



- direct reading
- virtually automatic
- 90-95% accurate
- simple operation

WIDE APPLICATION RANGE!

Determines the thickness of brass, cadmium, decorative and heavy chromium, copper, lead, lead-tin, nickel, silver, tin, tin-zinc, and zinc deposits on various basis-metals. The thickness range is from 2-3 millionths up to 0.002". In addition, composite coatings can be tested. You get individual readings of the ACTUAL thickness of each deposit.
You can also test deposits on wire with Accessory Unit Model WT. (A.S.T.M. Spec. B-298-55T for testing silver coated copper wire.)

DEPENDABLE ACCURACY!

Accuracy is 90-95%. Human error is virtually eliminated. A positive "Calibration" feature monitors both accuracy and performance.

SIMPLE OPERATION!

Just set up the specimen and press a button. The average test takes about 1 minute . . . readings are direct.

15 DAY FREE TRIAL!

Try it in your own plant for 15 days. See for yourself how it works . . . what it does . . . how well it suits your application. Your satisfaction is guaranteed.

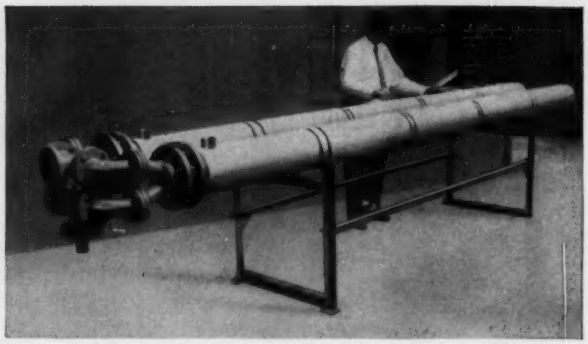
FREE EVALUATION OF APPLICATION

Just send us full details concerning your application including the plating/basis metal combinations and thickness range of each . . . or, just write for Bulletin 400. There's no charge . . . no obligation.

● KOCOUR testing sets are used all over the world for controlling plating — cleaning — pickling — anodizing — and hardening processes . . . special sets can be provided for your requirements.
Write today for complete information — no cost or obligation.

KOCOUR COMPANY
4802 S. ST. LOUIS AVENUE
CHICAGO 32, ILLINOIS

Specify KOCOUR test sets from your supplier.



Heil Nocordal Heat Exchangers with 15 Foot Long Impervious Graphite Tubes for Heating Sulphuric Acid Anodizing Solution.

For

- **Utmost Corrosion Resistance**
- **High Heat Transfer**
- **Thermal Shock Resistance**
- **Low Cost Operation**

Specify

Heil Nocordal Grid-type Heat Exchanger in Refractory Lined Tank.

HEIL of Cleveland

NOCORDAL *IMPERVIOUS GRAPHITE*

Shell and Tube, and Immersion Type

HEAT EXCHANGERS

Heil Nocordal Grid-type Heat Exchanger for Mounting in Bottom of Tank Concentrating Solutions of Rare Metallic Salts.

You can overcome even your toughest corrosion problems when you specify Heil proven Nocordal exchangers. Nocordal is unsurpassed for practically any chemical processing application; can be used safely with most all acid solutions and is non-metallic; consequently, it avoids any metallic contamination.

Available in a wide range of proven, pre-engineered shell and tube exchangers, steam or electric immersion heaters, also steam jets to agitate and heat tank solutions.

Get full details. Send for Bul. No. 156 today!

CHEMICAL-PROOF LININGS · TANKS HEATERS PLASTICS

HEIL PROCESS EQUIPMENT CORPORATION

12914 Elmwood Avenue • Cleveland 11, Ohio

Harshaw announces

NiChlor 31

a significantly improved nickel chloride

IMPROVEMENTS:

- Non-caking
- Contains more nickel —less bulk
- Easier handling
- More uniform particle size
- Same cost per pound of nickel
- Quick dissolving characteristics

A new nickel chloride with less water of hydration demonstrating marked improvements over that previously available to Platers has been developed by The Harshaw Chemical Company.

Called "NiChlor 31," this new product has a typical average of 31% nickel compared with 24.5% in ordinary nickel chloride. This means that .8 lb. of "NiChlor 31" is equivalent to 1 lb. of regular nickel chloride, and results in easier handling and storing.

"NiChlor 31" is non-caking, uniform, and of high purity with quick dissolving characteristics. On the basis of nickel content, "NiChlor 31" is offered at no increase in cost.

Complete information may be obtained by contacting The Harshaw Chemical Company, 1945 East 97th Street, Cleveland 6, Ohio.

Write for FREE Booklet, "HARSHAW'S COMPLETE SERVICE to the PLATING INDUSTRY"

HARSHAW

THE HARSHAW CHEMICAL CO.

1945 EAST 97th STREET • CLEVELAND 6, OHIO

Chicago • Cincinnati • Cleveland • Detroit • Hastings-On-Hudson
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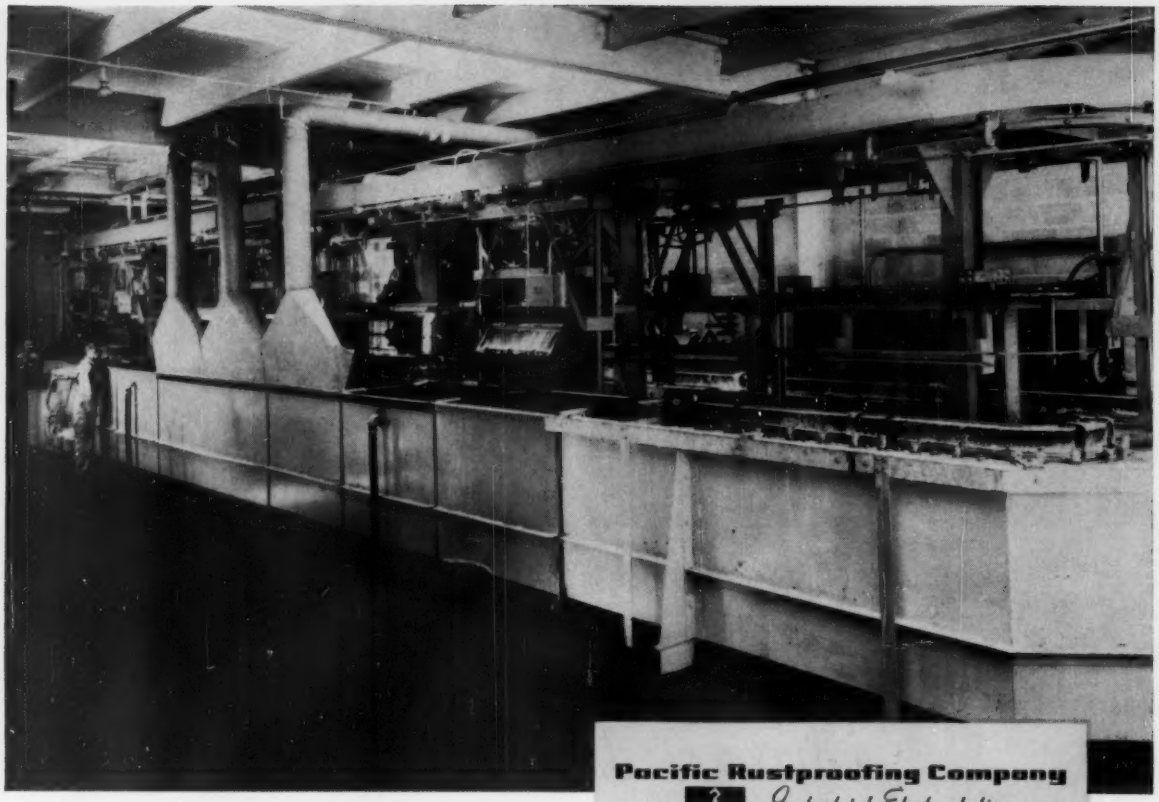


Crown "MP" gets diversified zinc plating production out on time at low cost for Pacific Rustproofing Co.

Crown MP (Multi Purpose) is the most versatile of all automatic processing equipment for meeting the output and speed demanded in modern production. The key to "MP" versatility is an ultra-modern automatic programming and control system, of far advanced design. The "MP" can process several different jobs simultaneously; for example, two or three dissimilar metals can be plated in racks or barrels at two different voltages. The "MP" handles an astonishing range of sizes and weights . . . parts from ¼ inch to 40 feet; and from fractions of an ounce in weight to tons can be processed.

Besides helping to cut costs and meet production schedules, the "MP" improves product quality by precisely timing the processes.

If you have a continuous dipping process, find out what Crown Automation can do for you . . . write for Bulletin "MP" today.

Pacific Rustproofing Company

Industrial Electroplating

1733 PERALTA STREET • OAKLAND 7, CALIFORNIA • PHONE HIGATE 4-7233

Since 1956 this Crown "MP" Automatic Barrel Plating Machine has been in operation and doing an extremely satisfactory job of handling our daily zinc plating production. The variable time in the acid gives us the option of a mild or severe pickling and also the choice of either a clear or yellow chromate; these together with a variable zinc plating time enable us to process a wide variety of work. Processing specification work on schedule is an important factor in our operation.

Pacific Rustproofing Co.

Robert M. Hart

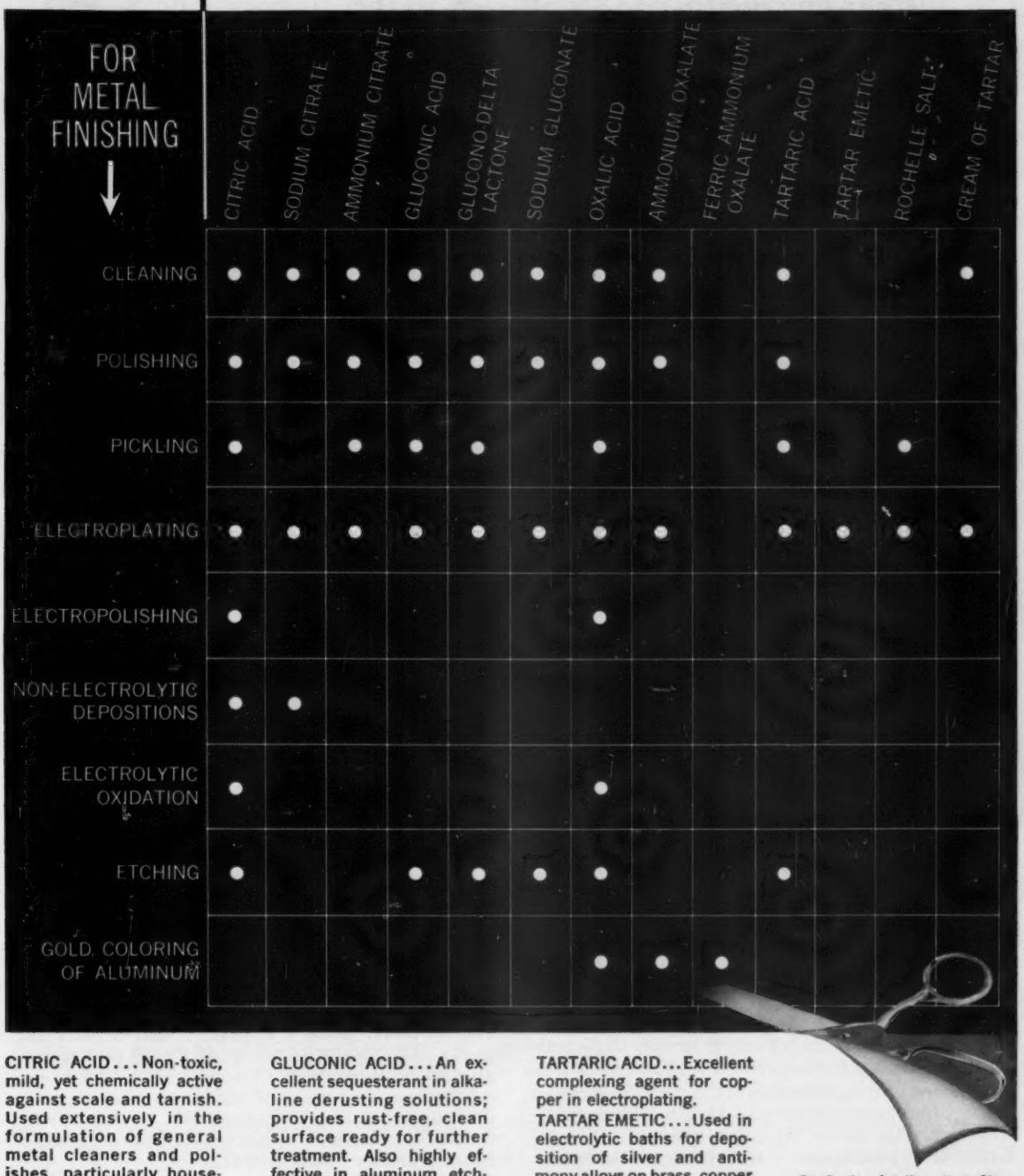
Vice-President

CROWN

CROWN RHEOSTAT and SUPPLY COMPANY

1965 PRATT BOULEVARD • ELK GROVE VILLAGE, ILLINOIS • (A SUBURB OF CHICAGO)

DEPENDABLE PFIZER CHEMICALS



CITRIC ACID... Non-toxic, mild, yet chemically active against scale and tarnish. Used extensively in the formulation of general metal cleaners and polishes, particularly household products.

SODIUM CITRATE... A preferred ingredient in electroless nickel baths, resulting in a brighter plate. Also finds wide use in electroplating processes.

AMMONIUM CITRATE... Especially useful for the removal of rust in near neutral solutions. Extremely mild and safe to handle.

GLUCONIC ACID... An excellent sequesterant in alkaline derusting solutions; provides rust-free, clean surface ready for further treatment. Also highly effective in aluminum etching and paint stripping compounds.

OXALIC ACID... The most effective chemical for use in automobile radiator cleaners. Also finds wide use in electropolishing and as an ingredient in general metal cleaners.

FERRIC AMMONIUM OXALATE... Used extensively in the production of light-fast gold-colored aluminum.

TARTARIC ACID... Excellent complexing agent for copper in electroplating.

TARTAR EMETIC... Used in electrolytic baths for deposition of silver and antimony alloys on brass, copper and steel surfaces.

ROCHELLE SALT... Increases efficiency and yields finer-grain deposit in alkaline copperplating.

CREAM OF TARTAR... An excellent additive for brass and aluminum cleaning compounds. Its crystalline structure acts as an effective abrasive in paste polishes. Chemically active against tarnish.

For further details write to Chas. Pfizer & Co., Inc., Chemical Division, Brooklyn 6, New York.

Science for the world's well-being®

Pfizer

CHEMICAL DIVISION

Want low-cost parts finishing?

NOW—CHOOSE FROM

7 NEW ALMCO VIBRASHEEN MACHINES

TO DO YOUR

- **DEBURRING**
- **DESCALING**
- **BURNISHING**
- **SURFACE REFINEMENT**
- **CLEANING**

10 to 100 Times FASTER!

7 SIZES FOR EVERY JOB REQUIREMENT

Model	Tub Capacity	Tub Size, Inside		
		Length	Width	Height
VT-70	¾ gallon	7″	4¾″	6″
VT-71	1 cu. ft.	12″	12″	12″
VT-72	2½ cu. ft.	15″	16″	18½″
VT-75	5 cu. ft.	31″	17″	19½″
VT-77	7 cu. ft.	31″	17″	22½″
VT-712	12 cu. ft.	35″	25″	30⅜″
VT-717	17 cu. ft.	47″	25″	30⅜″

New VT-72 Vibrasheen being unloaded into optional hoist-pan. Note convenient height of controls.

ANOTHER REPORT FROM THE ALMCO ALBUM OF NEW PRODUCTS

IT'S A FACT! With the seven (7) new ALMCO Vibratory Machines, you can expect finishing time cycles 10 to 100 times faster than with standard horizontal barrel finishing equipment. It's a significant production break-through, made possible by creating constant vibratory motion to activate the entire mass of media and parts in the finishing container, as compared to only 20% activation with conventional barrel finishing methods.

The uniform vibratory motion of the media in recessed areas, blind holes and small I.D. dimensions make it possible to obtain optimum results on a multitude of applicable parts with intricate configurations that can not be completely processed in standard horizontal barrel machines.

What's more, this amazing metal finishing machine only requires 50% of the floor space that is taken up by any other machine of this type with a similar capacity. Time and motion is at the absolute minimum with all convenient operating conditions.

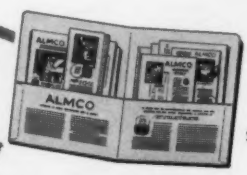
Tub features. Holds a 2½ cu. ft. load of parts and media. Equipped with vibrating mechanism adjustable for impact range of from 600 to 2550 lbs.; has a vibration frequency of 3380 rpm with variable drive optional. Pivots through 180° arc. Lined with tough ⅜″ plastisol. Quick-acting cam-lock drain door facilitates flushing of tub.

Investigate today, the ALMCO *Vibra-Sheen way!*

FREE

NEWS ABOUT ALMCO'S NEW PRODUCTS

New Almco Album describes the latest in metal finishing machines, methods and media. Write today for free copy!



ALMCO

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SALES AND ENGINEERING OFFICES: Chicago, Detroit, Los Angeles, Newark, New Haven, and Philadelphia

IN ENGLAND: Almco Division of Great Britain, Ltd., Bury Mead Works, Hitchins, Herts, England

WHAT'S NEWS IN ENJAY RESINS FOR SURFACE COATINGS

Alkyd Melamine
After 500 Hours
Salt Spray

Epoxy Ester
After 700 Hours
Salt Spray

Buton 200
After 700 Hours
Salt Spray

BUTON® 200 Resin offers better corrosion resistance—saves up to 1/3 the cost

In a recent series of salt spray tests, Buton 200 Resin outperformed epoxy ester and alkyd melamine formulations. All samples were automotive primer formulations with equivalent pigmentation. Test results? The Buton based primer had the lowest creep of all three. Impact testing also revealed that Buton-based primers had good adhesion, flexibility and impact resistance. By selecting Buton 200 Resin, you can save up to ⅓ on metal primers. Samples and a booklet on Buton Resins for metal primers may be obtained by writing to 15 West 51st Street, New York 19, N. Y.

EXCITING NEW PRODUCTS THROUGH PETRO-CHEMISTRY

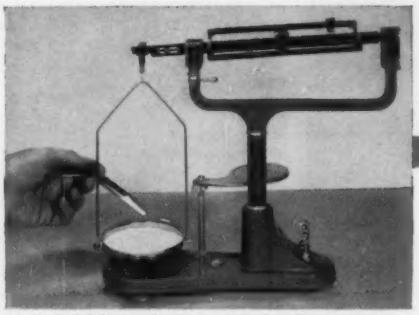
ENJAY CHEMICAL COMPANY

A DIVISION OF HUMBLE OIL & REFINING COMPANY

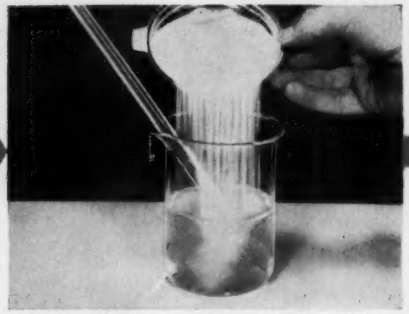
ENJAY RESINS

Here's how you can save time, and mixing errors with either

New "Direct-Route" Method



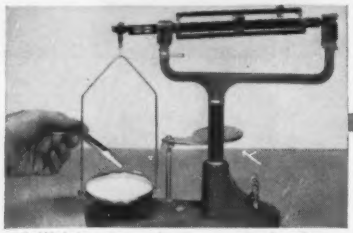
1 Just weigh required amount of sodium-copper or potassium-copper double salt.



2 Dissolve the desired double salt in water or plating solution.

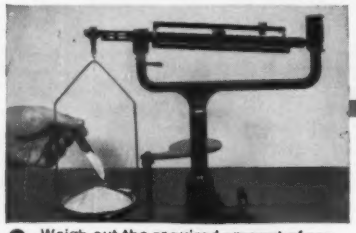
Laboratory demonstration shows how "direct-route" method saves time

Old "Indirect" Method



1 Weigh out required amount of sodium or potassium cyanide.

2 Dissolve the sodium or potassium cyanide in water.



3 Weigh out the required amount of copper cyanide.

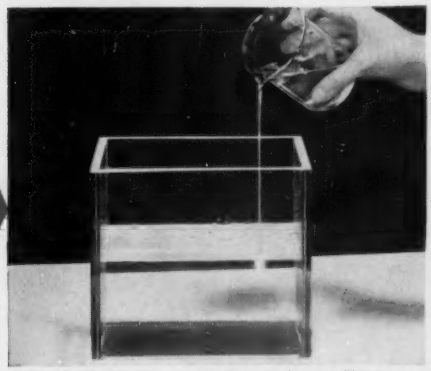
4 Add copper cyanide to water and make a slurry.

5 Dissolve the copper cyanide slurry in solution of sodium or potassium cyanide.

CALL DU PONT FOR ANY ONE OF THESE QUALITY PLATING PRODUCTS. You're assured of superior quality, dependable supply and expert technical service with plating chemicals from Du Pont... your reliable domestic source.

- **Sodium-Copper Cyanide Double Salt**
- **Potassium-Copper Cyanide Double Salt**
- **Copper Cyanide**
- **Potassium Cyanide**
- **All-purpose Cyanobrik® sodium cyanide (in briquette form)**
- **Cyanogran® M sodium cyanide (in granular form)**

reduce handling, avoid waste of Du Pont's Double Salts...



3 Add directly to plating tank—no filtering necessary.

...avoids errors.

6 Add solution through a filter to plating tank.

SODIUM-COPPER CYANIDE
OR
POTASSIUM-COPPER CYANIDE

SAVE TIME AND REDUCE HANDLING...By using one Du Pont copper cyanide double salt instead of two separate chemicals, you eliminate several steps usually required to dissolve copper cyanide. Just weigh out the Du Pont double salt and dissolve it in water or plating solution. A "direct-route" process! (Compare old and new methods at left.)

AVOID WASTE AND MIXING ERRORS...because active ingredients are in the proportions usually required. This simplifies making and replenishing bath . . . prevents waste resulting from undissolved copper cyanide.

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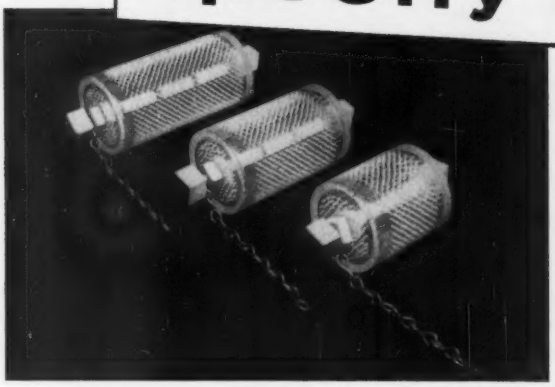

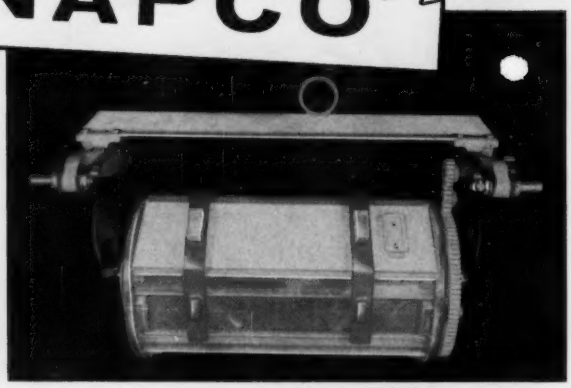

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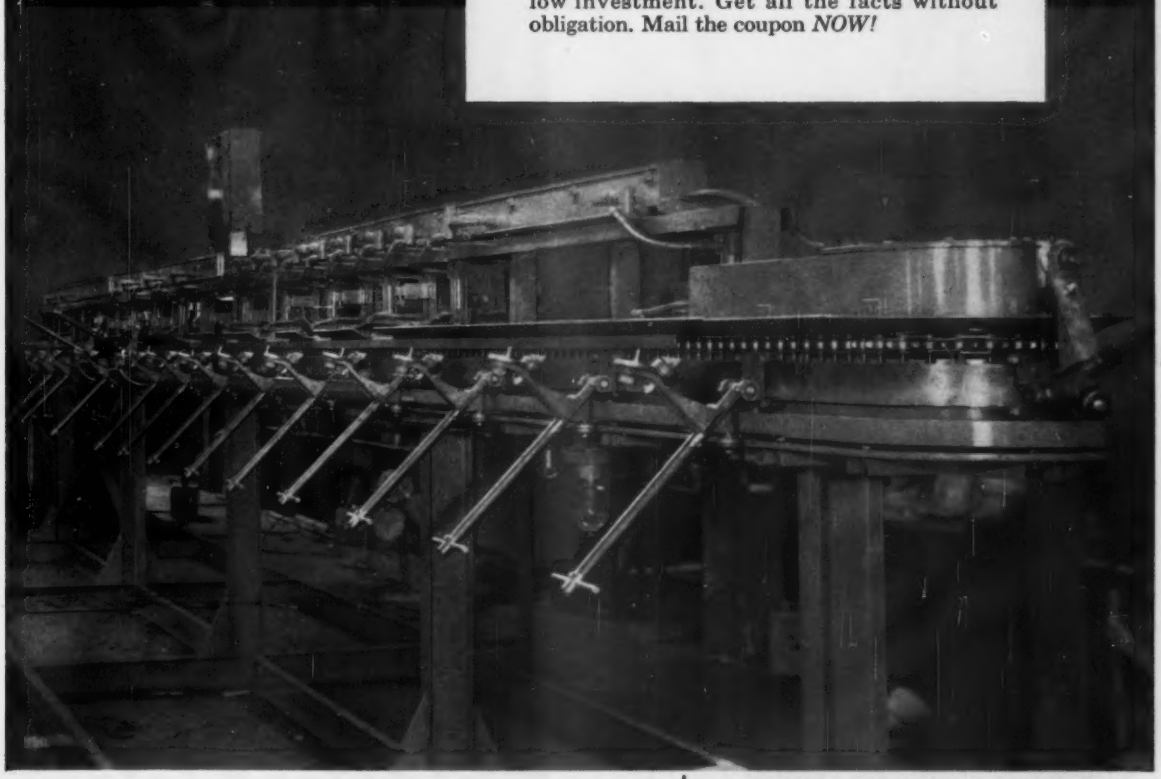

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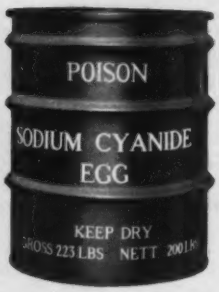

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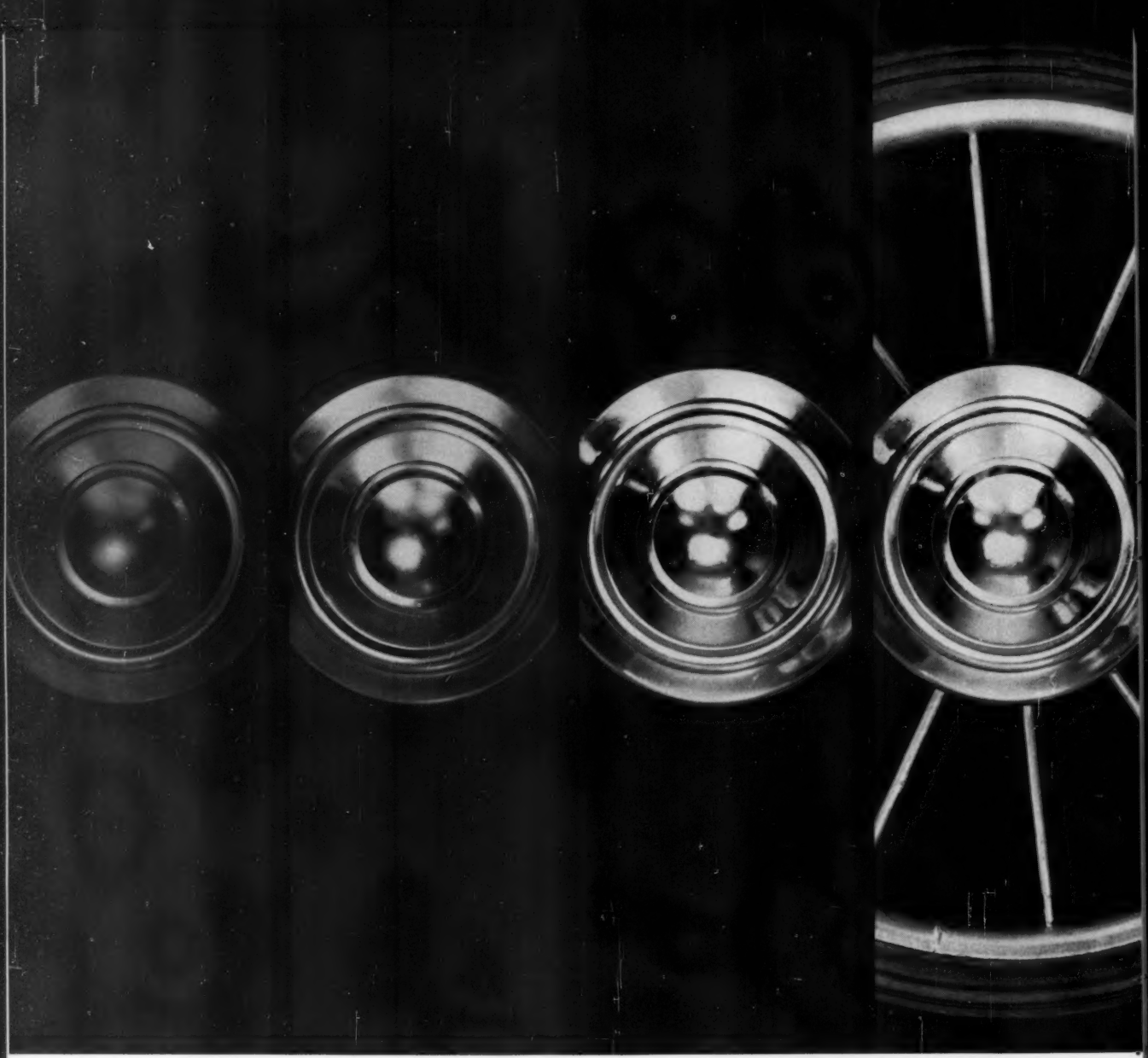

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MARCH, 1961 Volume 59 No. 3

FEATURES

Editorial — Ultrasonic Cleaning — Know What You're Doing! 39

The Corrosion Protection of Magnesium in Electronic Equipment 40
By Harold Shapiro

Determining Cloth Content of Bias Buffs 46
By E. L. Johnson

Cycling Trends in Decorative Finishes are Turning Back to the Originals 49
By E. A. Zahn

Synthetic Resins — Part VI 51
By Harold P. Preuss

Improving Convair's Finishes 55
By Thomas A. Dickinson

Current-Distribution Improving Aids 57
By Robert H. Rousselot

Science for Electroplaters — Part LXIV 66
By L. Serota

DEPARTMENTS

Shop Problems	64	Recent Developments	74
Professional Directory	65	Business Items	86
Foreign Literature	69	News from California	95
Patents	71	Manufacturers' Literature	98

Associations and Societies 101

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ESTABLISHED 1903 VOLUME 59 • NUMBER 3 • MARCH, 1961

ULTRASONIC CLEANING - KNOW WHAT YOU'RE DOING!

We recently heard a finishing supervisor sound off rather vehemently to the effect that ultrasonic cleaning was not all it was cracked-up to be. After a considerable investment, he had found that the results with his baskets of parts were not a whit better than he formerly obtained by mechanically dunking up and down in his soak tank. We waited patiently until he was all through, then innocently inquired whether he had ever heard of acoustically-designed baskets, knowing the answer in advance, of course.

This reaction is typical of a situation where a new process is instituted without sufficient consideration of the basic factors involved. There is no question any more but that, aside from poking-out with an ice-pick, ultrasonics is the most effective method presently available for removing packed-in dirt, especially from very deep recesses and blind holes. But, obviously, it has to be employed correctly. In the case of basket cleaning or degreasing, the complainant was not aware of the dampening effect of the vibrations focused through a screen. A basket with the largest possible mesh should have been used, consistent with the size of the parts. One does not just make-do with one's old baskets. If the transducers are on the bottom of the tank and focused upward, as most of them are, the baskets should have flat or coned sheet metal bottoms and mesh sides. In extreme cases, transducers have recently been mounted on the basket itself. Positioning of parts, whether in baskets or on racks, will have a considerable influence on cleaning efficiency, a consideration not restricted to this particular method of dirt removal.

The wrong cleaner and improper operating temperature are other malefactors for whose consequences the whole process may be accused unjustly. Those who make it their business to keep up with new finishing developments are aware that the cleaning action depends on *cavitation,* the formation and collapse of vapor bubbles due to high frequency vibrations emanating perpendicularly from the face of the transducer. It is also axiomatic that soil removal becomes more effective as the cleaner temperature is raised. However, many are not aware that cavitation in water is at a maximum at about 140-160°F., and will practically cease if the temperature is increased beyond that, whereas, hydrocarbon solvents cavitate beautifully at room temperature. The removal of dissolved gas, which can reduce ultrasonic efficiency tremendously, is accelerated by adding a wetting agent to the cleaner. But, a wetting agent which is effective in a conventional soak cleaner may entrap air and turn out to be quite unsuitable for use with ultrasonics.

Our comments are not intended to be a dissertation on the theory and practice of ultrasonic soil removal. What we are driving at is that, like any tool, it must be used intelligently in order to obtain results. The equipment is good, and special cleaning solutions are available where needed. Also available is the valuable experience of their manufacturers, which many often forget to take advantage of.

Nathaniel Hall

The Corrosion Protection of Magnesium in Electronic Equipment*

By Harold Shapiro, *Sylvania Electric Products Inc., Buffalo, N. Y.*

Harold Shapiro studied chemistry at the University of Buffalo. He joined Sylvania Electric Products, Inc., in 1952, is now chief chemist at Sylvania's Electronics Systems Division Buffalo operation. Mr. Shapiro has gained a reputation as an authority on chemistry of materials related to the electronics industry. He has written several technical articles on this subject and has lectured throughout the country. Association memberships: president, Buffalo Branch, American Electroplaters' Society; member of National Management Association.

THE use of magnesium in military electronic equipment has caused the raising of eyebrows for a good many years. With the advent of supersonic and transonic aircraft and missiles, the factor of excess weight is of prime importance. The use of magnesium alloys as a structural material has been common in the major airframe companies, for quite some time. The frame of the plane or missile can go nowhere without its intricate electronic gadgetry, the vital nerve center, upon which its success or failure as an operational weapon depends, and some of these sophisticated "black boxes" can really add weight. The problem of light weight (or lighter) electronic equipment has become so important within the last few years, that weight reduction campaigns have literally invaded the electronic and electrical industries. The only topnotch lightweight engineering material that could possibly do the job was magnesium. The thought of using magnesium in electronic equipment which contains so many different materials, immediately raised the old specter of corrosion, since magnesium coupled with a dissimilar metal in proper atmospheric conditions corrodes "violently" like no other metal.

*Presented at the Annual Convention of the Magnesium Association, and published by permission of the Association.

Corrosion

There have been many fine papers written about corrosion, and corrosion of magnesium in particular. To better understand the mechanics of corrosion, it would be well first to discuss just how corrosion occurs. Basically, corrosion occurs when two dissimilar metals are coupled together electrically in an electrolyte, or some type of conducting solution. One of the metals becomes the anode, while the other metal becomes cathodic. Where the metals lie in relation to the galvanic series decides the potential differences between them. The greater the difference, the greater the tendency toward electrolytic corrosion. It must be remembered, for current to flow there must be either dissimilar metal to metal contact or an electrically conductive medium (an electrolyte). The Galvanic Series is a table of metals and alloys arranged in such an order that any metal in the series will be cathodic to any metal above it, or anodic to any metal below it. As can be seen by Table I, magnesium is at the top of the anodic end of the chart and is anodic to all other metals listed. In a galvanic cell, the anodic metal or anode is the metal that is dissolved or corroded by the electrolytic action and, needless to say, magnesium is always the first to go — unless it is properly protected.

TABLE I

Magnesium (alloys)
Zinc
Aluminum (alloys)
Cadmium
Iron (steel)
18:8 Stainless (active)
Copper (brass, bronze and alloys)
Nickel and alloys
Chromium
18:8 Stainless (passive)
Gold
Silver

TABLE II

Group A	*Group B*	*Group C*	*Group D*
Magnesium alloys (most anodic)	Aluminum	Zinc	Copper and its alloys
	Aluminum alloys	Cadmium	Nickel and its alloys
	Zinc	Steel	Chromium
	Cadmium	Lead	Stainless steel
	Tin	Tin	Gold
	Stainless steel	Stainless steel	Silver (Most cathodic)

Military electronics work is covered by scores of specifications; among these is MIL-E-5400 which details the requirements for the assembly of dissimilar metals, and which is the basis of the following:

ASSEMBLY OF DISSIMILAR METALS:

Dissimilar metals are not to be used in intimate contact unless suitably protected against electrolytic corrosion. Whenever it is necessary to assemble any combination of dissimilar metals, an interposing material compatible to each shall be used. As a supplment to Table I, Table II shows the Galvanic Series broken down into four groups. Contact between a number of any one group and a member of the same group is considered to be similar. Contact between a member of one group and a member of another group is considered to be dissimilar. This would be true, except for zinc, tin, and cadmium, as they appear in both groups B, C, and D.

Where reference is made to a metal in a particular group, the reference always applies to the metal on the surface of the part; that is, zinc means zinc castings, as well as zinc electroplate, zinc hot dip, or zinc metal spray.

PROTECTION AGAINST ELECTROLYTIC CORROSION:

Where it is necessary that any combination of dissimilar metals be assembled, the following methods or combinations of methods shall be employed for the alleviation of electrolytic corrosion, unless electrical considerations preclude the employment of such methods:

Interposition of a material compatible to each to decrease electrolytic potential differences, such as cadmium or zinc plate on steel in contact with aluminum.

Interposition of an inert material between the dissimilar metals to act as a mechanical and insulating barrier.

Application of organic coatings to the contact faces of each of the dissimilar metals, such as paint coats on steel and aluminum surfaces in contact.

Application of corrosion inhibitors to the faces of each of the dissimilar metals, such as zinc-chromate paste on nickel-plated brass screws in contact with aluminum.

Design of dissimilar metal or similar metal contacts, in order that the area of the cathodic metal is relatively smaller than the area of the anodic metal, such as screws of stainless steel or nickel-plated brass in contact with aluminum. This is very important.

Limitation of amount of aeration reaching the dissimilar metal faces, such as steel bolts in aluminum with all surfaces of contact sealed with an organic compound such as paint or plastic.

The oxide coatings which are formed on untreated magnesium do not offer any protection comparable to the natural oxide which forms on aluminum. Basically, there are two types of surface treatments used to protect magnesium against galvanic corrosion. These are the immersion and the electrolytic types. These types are illustrated in Table III. Some are only "pretreatments," but all offer some degree of protection.

At the firm's chemical laboratory in Buffalo, N. Y., an extensive program was undertaken, with the guidance of the engineering department, to evaluate the corrosion resistance of magnesium treated by immersion and electrochemical techniques. It was the decision of the lab that none of the processes listed in Table III were entirely satisfactory for close contact multimetal electronic applications, even though their suc-

TABLE III

Treatment	*Designation*	*Method Applied By —*
Chromic Acid Pickle	MIL-M-3171	Immersion
Sulfuric Acid Pickle	——	Immersion
Bright Pickle	Dow 15	Immersion
Acetic Acid Pickle	——	Immersion
Chrome Pickle	MIL-M-3171 Type I (Dow 1)	Immersion
Sealed Chrome Pickle	MIL-M-3171 Type II (Dow 10)	Immersion
Dichromate Pickle (Acid)	MIL-M-3171 Type III (Dow 7)	Immersion
Dichromate Pickle (Alkaline)	MIL-M-3171 Type III (Dow 8)	Immersion
Galvanic Anodize	MIL-M-3171 Type IV (Dow 9)	Electrochemical
H. A. E.	MIL-C-13335	Electrochemical
Dow Anodize	Dow 17	Electrochemical
Manodyz	——	Electrochemical

cess is a known fact in nonelectronic applications. This statement will be considered by many as heresy, but the test results substantiate it.

Protection by Electroplating

At this time, electroplating magnesium with tin was investigated for both its ability to protect against corrosion, and for its advantages in electronic applications, mainly solderability and grounding. The basic procedure for plating magnesium is a development of the Dow Chemical Co., as follows:

IMMERSION ZINC COATING:

A) Bath Formula

Zinc sulfate, monohydrate	25 lbs.
Tetrasodium pyrophosphate	100 lbs.
Potassium fluoride	5 lbs., 14 oz.
Potassium carbonate	4 lbs., 3 oz.
Water	to make 100 gals.

B) Operating Conditions

Temperature	175 to 185°F.
Agitation	Mild
Immersion time	3 to 10 minutes
pH	10.2 to 10.4 (colorimetric)

C) Analytical Control

Zinc sulfate, monohydrate	3.5 to 8 oz./gal.
Tetrasodium pyrophosphate	24 to 30 "
Potassium fluoride	0.8 to 1.2 "

These limits are not critical; consequently the bath is easy to operate.

COPPER STRIKE:

A) Bath Formula

Copper cyanide	5.5 oz./gal.
Sodium cyanide	6.6 "
Sodium carbonate	4.0 "
Rochelle salts	7.0 "

B) Operating Conditions

Temperature	75 to 120°F.
Immersion time	5 minutes
Current density	20 to 30 amp./ft.^{2}
Anodes	High purity copper
Filtration	as required

COPPER PLATE:

A) Bath Formula

Copper cyanide	4.5 oz./gal.
Potassium cyanide	8.5 "
Potassium carbonate	6.5 "
Rochelle salts	5.5 "

B) Operating Condition

Temperature	150 to 160°F.
Current density	20 to 30 amp./ft.^{2}
Anodes	High purity copper
Filtration	as required

It has been found that, for best results, the final thickness of copper should be applied in the conventional copper plating tank, rather than try to apply the heavy copper by prolonged time in the strike bath. Oddly enough, strike bath plating has found some acceptance in job shops plating on magnesium.

TIN PLATING:

Potassium stannate	13.5 to 15 oz./gal.
Potassium hydroxide	1.75 to 2.5 "
Temperature	66° to 88°C.
Anodes	high purity virgin tin
Filtration	as required

The following thicknesses for copper and tin plating (subsequently fused or reflowed) were determined to give the maximum amount of corrosion protection during salt spray tests. (Salt spray tests were conducted per MIL-STD-151, using both the 5 and 20% salt concentrations.)

Copper	0.0015" to 0.002"
Tin	0.0002" to 0.0003"

SOLDER PLATE:

Evaluation was made at this time in substituting an electroplated solder (60% tin, 40% lead) in place of the tin electroplate. Although the fused solder had better appearance, salt spray tests both at 5 and 20% proved the alloy to be less resistant to corrosion. The solder plating bath used is as follows:

A. Bath Formula (100 gal.)

Stannous fluoborate (47%)	19.7 gal.
Lead fluoborate	5.3 "
Fluoborate acid	5.2 "
Boric acid	10.3 pounds
Peptone	4.2 "
Water	69.8 gal.

B. Operating Conditions

Temperature	60 to 100°F.
Current Density	30 to 45 amp./ft.^{2}
Anode Composition	60% tin/40% lead
Filtration	as required

C. Control

Total tin	8 oz./gal.
Stannous tin	7.4 "
Lead	3.4 "
Free fluoboric acid	5.4 "
Free boric acid	3.4 "
Peptone	0.67 "

One of the first problems to be overcome to successfully utilize tin, was the inherent porosity of the plating. With tin plate, fusing or flowing of the deposit could be accomplished in a bath of hot fat or oil. (Fusing of the tin plate is not new, and has been used successfully by many of the large electronic firms to eliminate porosity on tin plated magnesium parts). At Sylvania, many fats and oils were tested both

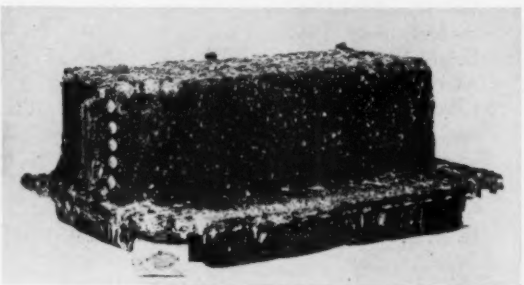


Fig. 1. After 50 hour salt spray.

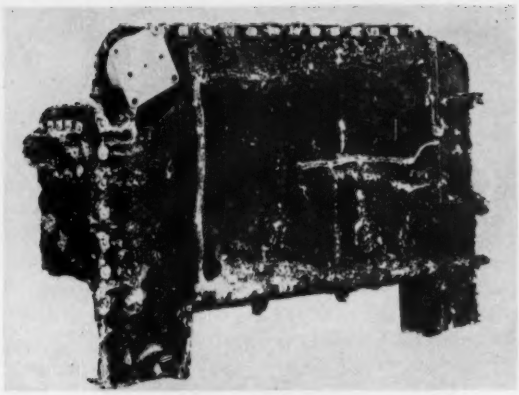


Fig. 2. After 50 hour salt spray.

for their uniformity of "wetting" the tin, and for their stability for prolonged production use.

The fusing operation has two advantages. It seals any possible porosity and, aesthetically, the parts are vastly improved. The bright fused tin is resistant to fingerprinting and marking, whereas, the deposit directly from the plating bath is dull, and finger marks very easily.

One problem that was encountered was the reluctance of production platers to operate a 500°F. bath of hot oil. Many safeguards and elaborate protection equipment had to be provided for this operation. It might be well to note at this time that, in all of the salt spray tests performed, it was proven that the 20% solution was actually no more detrimental to the materials tested than was the 5% solution.

One point that might slip by the design engineer is the extremely thick coating of copper that is necessary to help insure the corrosion resistance of the part. This added weight in some applications could offset any weight reduction advantages originally contemplated by using magnesium. This, in some cases, justifies the use of aluminum. The breakoff point, where the weight of plating nullified the advantages of using magnesium to save weight in a system was the object of a full scale investigation at Sylvania.

Plating Control

To insure the ultimate in quality of the end product, the plating and processing tanks were kept under extremely rigid control by the chemical laboratory. Solutions were frequently analyzed and quality control tests were made a continuing function. After the magnesium parts were copper plated, they were subjected to a temperature of 350°F. for one hour to check for blistering or delamination of the plating. Parts that passed were reactivated and tin plated. The process and the controls imposed insured the final part to be as functional as the state of the art today could produce. With rigid controls of both the process and the personnel, it was found unnecessary to subject every part to the heat test, and a definite sampling plan could be used successfully.

Plating magnesium necessitates a complete reorientation of plating personnel. As most people are aware, plating can never be made a 100% science. A good percentage must be considered as "art." Science however, in the case of magnesium, must, by necessity, force the art percentage down. The dwell time in the zincate, the geometry of the plating rack setup, the solution constituents, all must operate under hard and fast rules. The sequence and timing of the plating cycle cannot be left to the discretion of the plater. This perhaps is one of the biggest obstacles to overcome before anyone can expect to successfully production plate magnesium.

The transition from laboratory scale to production is always difficult in any new plating process, but with magnesium the problems are multiplied. Many companies have decided against processing their own magnesium because of problems such as these.

Organic Coatings

Organic coatings are discussed separately because they have a specific need when utilized to protect magnesium. The thought that will immediately come to mind is, "When do you plate and when do you paint?" The plating of magnesium, in most cases, is primarily in the field of electronics. Magnesium in use structually, as in aircraft and missiles, can usually be given a good cleaning followed by an immersion treatment such as Dow #7, yielding a fairly good paint base. In the field of electronics, where the basic problem of dissimilar metals threatens the corrosion resistance of the magnesium, very little has been done to use organic coatings to protect where there is no actual need for an electroplate.

At Sylvania-Buffalo the "black-box" itself was thoroughly evaluated to determine the best organic coating system to use. Protection was vital, as the box was assembled with dissimilar metals in outside contact with the atmosphere. It was quickly discovered that the primers and topcoats that were excellent in performance with steel or aluminum were sadly inadequate in their protection of magnesium.

A complete test series of paint systems and their salt spray resistance on actual magnesium castings were conducted. The first paint system used consisted of a standard military specification zinc chromate primer and a standard baking enamel topcoat over a Dow #7 chromate. All of the fasteners used were of the materials recommended by the magnesium industry. The assembled painted casting was then subjected to a 50 hour 20% salt spray. Figure I shows the top view of the casting immediately after removal from the salt spray chamber. Figure 2 shows a bottom view of the same casting. Figure 3 shows a view of the same

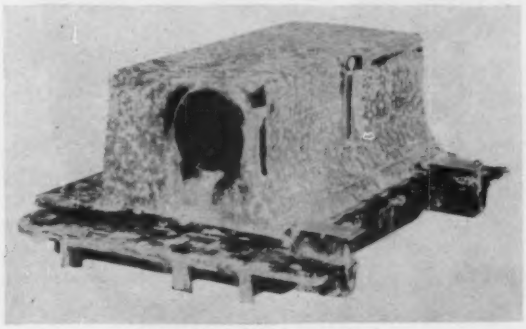


Fig. 3. After 50 hour salt spray.

casting after a bit of cleaning up. The surface is almost completely eaten away by corrosion. The corrosion products weighed a surprising 1.4 pounds.

After the discouraging results of the foregoing tests a more sophisticated system of paints was evaluated. Once again, all of the proper hardware was used with accepted industry methods of assembly. The following procedure was used.

1. One coat of pretreatment MIL-C-15328 to be applied per MIL-C-8507 (over Dow #7)

Wash Primer	4 parts
Activator (phosphoric acid)	¼ part
Reducer	1½ to 2 parts

2. One coat of black baking enamel.

The finished casting assembly was then subjected to the same salt spray test. Figures 4 and 5 picture two different views of the assembly after salt spray. The corrosion resistance of this paint system was vastly superior to the first. However, corrosion was still evident in the immediate areas of the dissimilar metal couples. It was then the assigned task of the chemistry laboratory to provide a paint system that was as close as possible to being completely corrosion resistant. A good reproducible quality system was needed.

An entire series of organic finishes was evaluated. Among them were lacquers, enamels, alkyds, acrylics, modified melamines and, last but not least, vinyl plastisols and organosols.

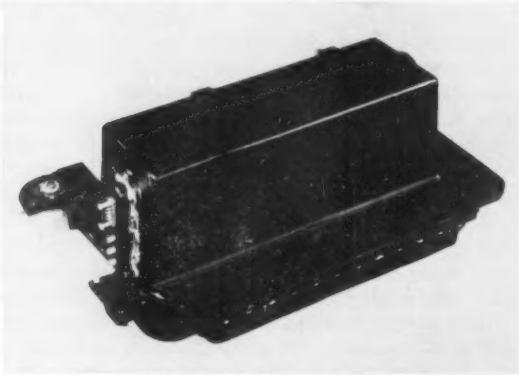


Fig. 4. After 50 hour salt spray.

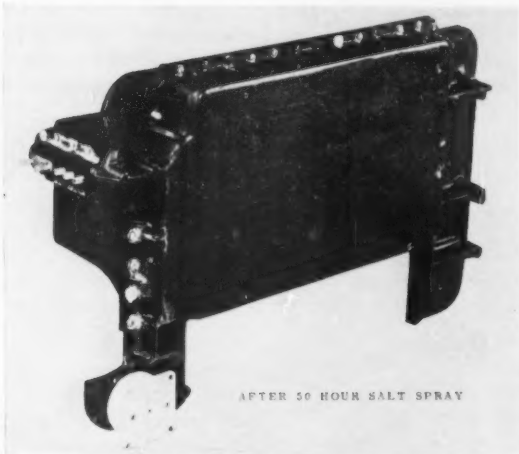


Fig. 5. After 50 hour salt spray.

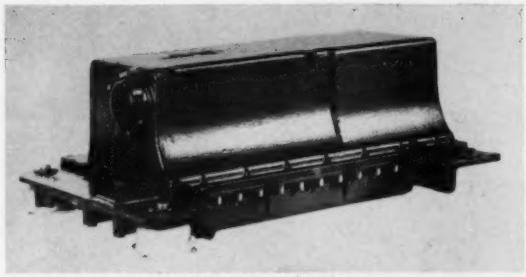


Fig. 6. Before 50 hour salt spray.

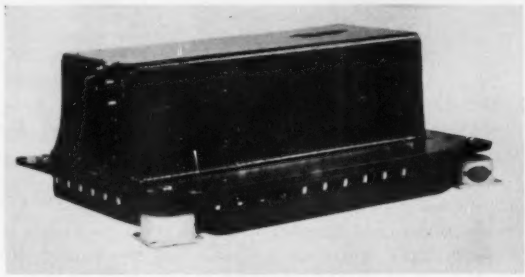


Fig. 7. Before 50 hour salt spray.

Vinyl Plastisols and Organosols

It was this group of materials that gave the magnesium what was considered to be the ultimate in protection against corrosion. Plastisols are identified as a dispersion of vinyl resin in a plasticizer. An organosol is basically the same, but with the volatile solvent included.

The chemicals present in the liquid stage of a plastisol are present in the solid stage also. The solvent present in an organosol must be removed before the fusion or solidification can be accomplished. The resin used primarily in these formulations is polyvinyl chloride of a high molecular weight. Copolymers are also utilized. It was the organosol rather than the plastisol that lends itself to the spray application method that the company was most interested in. Most people who are at all familiar with plastisols, know that most of the coatings are applied by dipping. Here again it is necessary to apply as thin a coating as possible to eliminate or preclude any excess weight being added.

The foregoing discussion was made because, out of the first six commercial organosols tested, only one was approved for potential use. Appearance-wise, they all looked the same. A total of twelve different commercial primers were evaluated in order to find one compatible with the organosol, and exhibiting good adhesion to the cleaned and chromated magnesium.

The "primer" in this case is not one such as zinc chromate, which is actually the first coat of paint. A primer for organosols or plastisols is usually a very thin colorless film. Without this primer, the cured coating could be peeled like a banana. The sole purpose of this primer is for adhesion. After the spraying techniques were evaluated, test panels were prepared and dissimilar metals, such as were used on the actual casting, were salt spray tested. The one problem left

was how to seal those areas such as screws and bolts that were used to "button up" a completed assembly. Air-dry vinyls were tested and approved. This basically is a vinyl dispersion in a highly volatile solvent. The air-dry coating hardened quickly and had good adhesion to the metal and to the surrounding organosol coating. The air dry vinyl was thin enough to be cut off easily if access to the assembly hardware was necessary. The material was also easy to reapply for field repairs. One other point that should be mentioned is the excellent properties of the plastic film electrically and chemically. In films of approximately 3 mils, a dielectric strength of 400 volts/mil is possible. Chemically, the cured organosols are resistant to strong mineral acids such as sulfuric and hydrochloric, strong alkalies such as sodium hydroxide, most electroplating solutions (they are used extensively in coating plating racks and equipment), and a variety of other chemicals.

A completely finished test unit was then subjected to 50 hours salt spray. Figures 6, 7, and 8 show different views of the assembly before exposure to salt spray. Figures 9, 10, and 11 show the same views after salt spray. It is quite interesting to note the very small amount of corrosion products. The only corrosion of any degree is exhibited only at the immediate areas of dissimilar metals. This was the ultimate obtainable.

At the time these tests were conducted, the laboratory was not aware of any other company conducting work and obtaining successful results on fused coatings. Since then, contact with other electronic companies has revealed similar successful usage of fused plastisol and organosol coatings. One deficiency the vinyl group displays is the inability to resist elevated temperatures. Hot spot application such as is encountered in high voltage electronic equipment cannot successfully utilize this type of coating. Many of the manufacturers of this type of material rate the temperature resistance at from 125 to 150°F., and many others, much less.

Fig. 8. Before 50 hour salt spray.

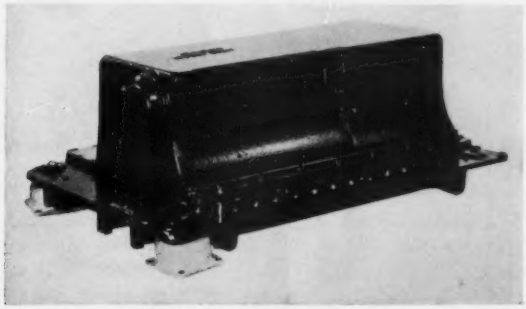


Fig. 9. After 50 hour salt spray.

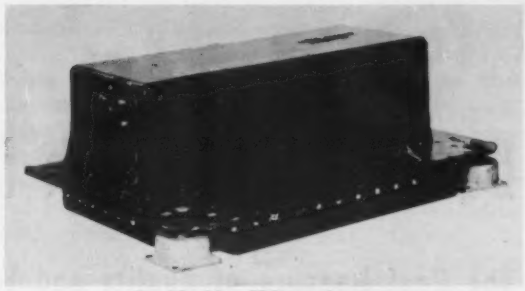


Fig. 10. After 50 hour salt spray.

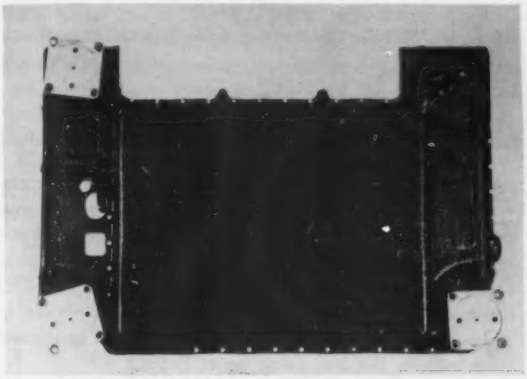


Fig. 11. After 50 hour salt spray.

Conclusion

The intent of this paper was basically to show the potential benefits that research and development will offer in the future use of magnesium products. Better methods are needed in the field of electroplating, as too many variables can influence the end product. Too many precautions and controls are necessary to insure the final corrosion resistance of an electroplated magnesium part. Foolproof plating processes must be developed to make plating magnesium as common as cadmium plating steel or copper.

More and more time must be spent developing new and better "exotic" organic coatings. There are many magnesium electronic parts plated today to withstand corrosion only. Where the plating is necessary for soldering or R.F. shielding, plating was specified correctly. However, where only corrosion resistance is the reason for plating, a lighter weight organic film, such as an organosol, could well replace the heavy electroplate. Until the designer has at his command realistic processes he knows can be duplicated and used successfully, many companies will turn to other metals that can be protected easily, for new designs.

In military applications, the supersonic and transonic aircraft and missiles are the losers. Every ounce of excess weight hurts. In one of our latest aircraft, one excess pound in electronic equipment can mean

(*Continued on page* 48)

Determining Cloth Content of Bias Buffs

The Real Measure of Quality and Value

By E. L. Johnson, *Vice President, Divine Bros. Co., Utica, N. Y.*

AS industry strives for improved efficiency, increasing stress is placed on achieving more economical production methods. In the finishing field, the emphasis is on tools that are more effective, more durable, faster but safer — tools of higher quality. To effect these economies, it's imperative that one be able to judge quality in the tools he buys; that he can make sure he gets the full value he is paying for.

Assuming proper and careful construction by a recognized manufacturer, utilizing cloth meeting specifications, the real measure of quality and value in buffs is their cloth content. The more cloth in a buff of a given diameter and construction, the greater its value in terms of effectiveness, durability and production life. And, cloth content is easy to determine.

While not the answer for every application, the predominant buff today is the closed-face bias type. It lends itself to economical automatic fabrication, has more versatility of application, and provides the most effective cutting face.

The key to determining the cloth content of a closed-face bias buff lies in understanding its method of fabrication, not alone in knowing its dimensions or number of ply. Because of the "gathered" nature of bias buffs, they acquire their real value from the amount of cloth packed into a buff of a given size.

Manufacture of bias buffs begins with cloth which is cut diagonally across the weave — on the bias — into widths appropriate for forming various sized buffs. To illustrate the process, we will assume the buff to be manufactured will be 14 inches in overall diameter, 16 ply, with a five inch center, (Fig. 1). The biased material is cut to a width of about 9½ inches (to allow for trim). Next, it is automatically wound onto a split drum (Fig. 2A). A 16 ply buff requires eight layers or turns of cloth on the drum (Fig. 2B). A diaphragm similar to a giant camera iris then is closed between the two parts of the drum, drawing the cloth off the drum and down to the desired center diameter of the buff (Fig. 2C).

At this point, various fastening methods are used by different manufacturers. In one standard method, after the diaphragm has been closed between the two parts of the drum, one part of the drum is pulled away while the diaphragm is holding the cloth at the center. A one-piece flat steel internal ring is then inserted into the center of the buff to bind it permanently together as an extra safety precaution against explosion of the buff in high-speed use. (Fig. 2D.)

Finally, an external steel fastening ring is clamped to the cloth around the inside center opening. (Fig. 2E.) A ventilated steel center plate containing an appropriate arbor hole is then fitted into the center opening of metal center buffs. The completed 14-inch diameter, 16 ply, 5-inch center, closed-face bias buff is then trimmed and tested and is ready for its customer.

Determining Cloth Content

Now let's measure its quality and value by determining its cloth content, step by step:

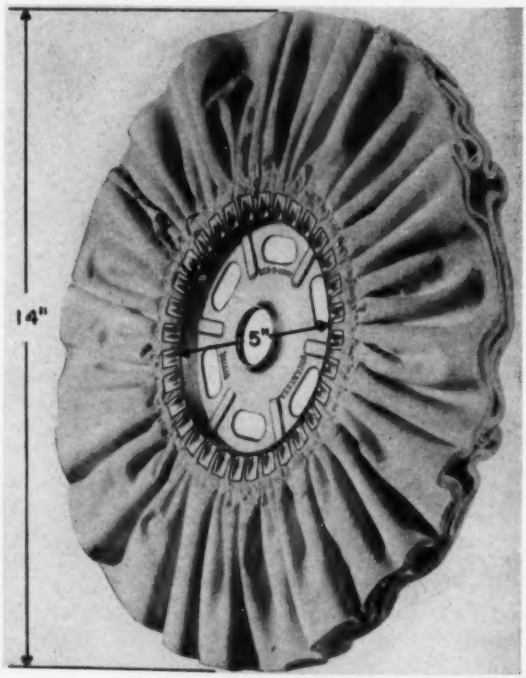


Fig. 1. Key dimensions of bias buff

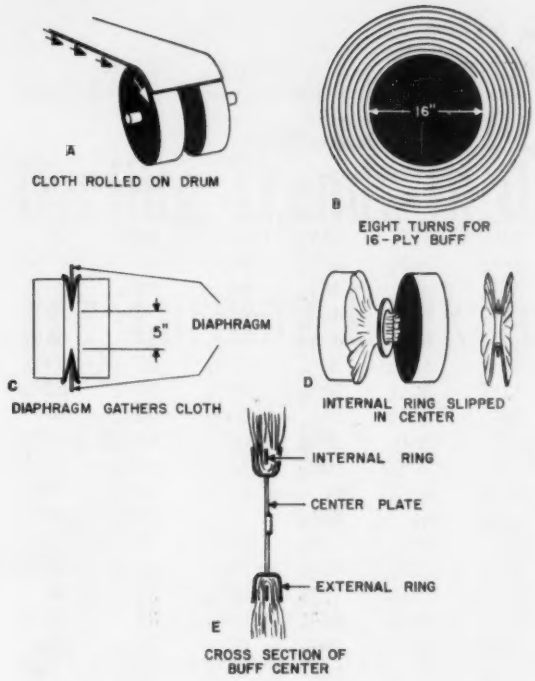


Figure 2

1. Lay it flat on a table and locate the end of the cloth strip it was made from by lifting the outer ply away from the rest of the buff. Mark the next ply with a pencil line indicating exactly where the strip ended. (Fig. 3A).

2. Using scissors, cut along the pencil line from the outside of the buff to the center fastening ring; then cut closely around the edge of the ring until this one complete ply is cut away from the rest of the buff. (Fig. 3B.)

3. You now have a wrinkled strip of cloth. Smooth it out flat on the table, being careful not to stretch it excessively, and measure its length in inches, measuring in 12-inch lengths for accuracy. (Fig. 3C.)

The strip cut from our 14-inch buff measures 50¼ inches long, and *this measurement is the key to determining the cloth content* of this particular buff.

Recall, now, that the strip cut from the buff was one complete ply, or *one turn around the drum* on which the buff was made. The length of the strip (50¼ inches) represents the *circumference* of the drum used to make the buff.

A drum with a 50¼-inch circumference has a rounded-off diameter of 16 inches. So our 14-inch diameter buff was made on a 16-inch diameter drum; since the drum diameter (16 inches) is two inches greater than the finished buff diameter (14 inches), the buff is a Type *Number 2*. The "Number 2" represents the difference in inches between the diameter of the finished buff and the diameter of the drum on which it was made. The greater the difference between the diameter of the buff and the diameter of the drum, the more cloth is packed into the buff and the greater its cloth content and value.

The type number of any closed-face bias buff can be determined by removing and measuring the length of one ply as described above. Locate this length in inches on the chart (Table 1) opposite the buff diameter and the number at the top of the chart will indicate the type number of the buff. If this type number corresponds to the type number on the order and invoice, the user has received the buff he paid for — and full value for his money, as far as cloth content is concerned and assuming true center diameter.

If it were a Number O buff (14-inch buff made on a 14-inch drum), each ply would measure at least 44 inches long, and the whole buff would have a total of 352 lineal inches of cloth in it (44 multiplied by the 8 turns on the drum). If it were a Number 6 buff (14-inch buff made on a 20-inch drum), each ply would measure approximately 63 inches long and the buff would have at least 504 total lineal inches of cloth in it. Each of these would be 14-inch, 16 ply buffs with 5-inch centers. But there would be a great difference in their value — their durability and efficiency — depending upon the amount of cloth packed into each and indicated by the buff type number.

It should be noted that the cloth content of buffs is described in various ways within the industry.

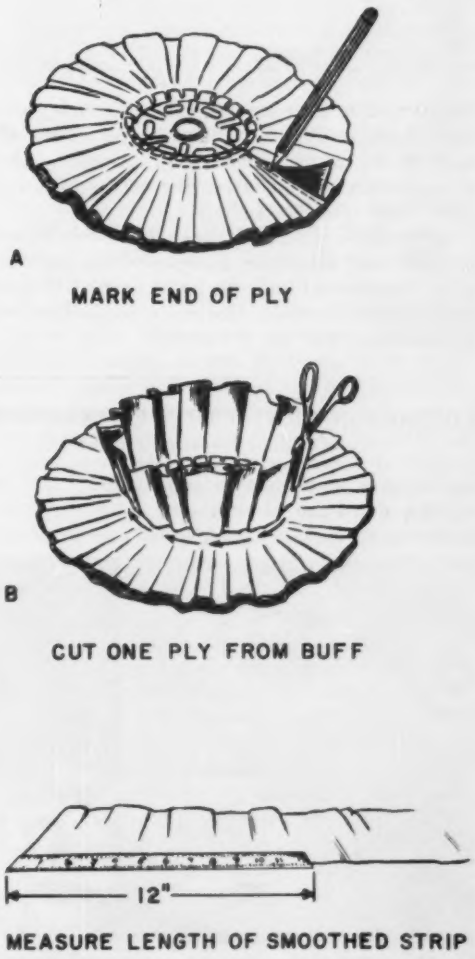


Figure 3

IDENTIFICATION TABLE
BIAS TYPE BUFFS

Length of Each Ply in Inches (Nearest 1/8 inch)

Buff Type Number

Buff Dia.	*0*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*
6"	18 7/8	22	25 1/8	28 1/4	31 3/8	34 1/2	37 3/4	40 7/8	44
7	22	25 1/8	28 1/4	31 3/8	34 1/2	37 3/4	40 7/8	44	47 1/8
8	25 1/8	28 1/4	31 3/8	34 1/2	37 3/4	40 7/8	44	47 1/8	50 1/4
9	28 1/4	31 3/8	34 1/2	37 3/4	40 7/8	44	47 1/8	50 1/4	53 3/8
10	31 3/8	34 1/2	37 3/4	40 7/8	44	47 1/8	50 1/4	53 3/8	56 1/2
11	34 1/2	37 3/4	40 7/8	44	47 1/8	50 1/4	53 3/8	56 1/2	59 3/4
12	37 3/4	40 7/8	44	47 1/8	50 1/4	53 3/8	56 1/2	59 3/4	62 7/8
13	40 7/8	44	47 1/8	50 1/4	53 3/8	56 1/2	59 3/4	62 7/8	66
14	44	47 1/8	50 1/4	53 3/8	56 1/2	59 3/4	62 7/8	66	69 1/8
15	47 1/8	50 1/4	53 3/8	56 1/2	59 3/4	62 7/8	66	69 1/8	72 1/4
16	50 1/4	53 3/8	56 1/2	59 3/4	62 7/8	66	69 1/8	72 1/4	75 3/8
17	53 3/8	56 1/2	59 3/4	62 7/8	66	69 1/8	72 1/4	75 3/8	78 1/2
18	56 1/2	59 3/4	62 7/8	66	69 1/8	72 1/4	75 3/8	78 1/2	81 5/8
19	59 3/4	62 7/8	66	69 1/8	72 1/4	75 3/8	78 1/2	81 5/8	84 3/4
20	62 7/8	66	69 1/8	72 1/4	75 3/8	78 1/2	81 5/8	84 3/4	88
21	66	69 1/8	72 1/4	75 3/8	78 1/2	81 5/8	84 3/4	88	91 1/8
22	69 1/8	72 1/4	75 3/8	78 1/2	81 5/8	84 3/4	88	91 1/8	94 1/4
23	72 1/4	75 3/8	78 1/2	81 5/8	84 3/4	88	91 1/8	94 1/4	XX
24	75 3/8	78 1/2	81 5/8	84 3/4	88	91 1/8	94 1/4	XX	XX

Terms used to refer to cloth content include: number. type, pack, style, density, and pucker. They all are used to mean the same thing. Another, simpler, measurement also has a bearing on the cloth content of a closed-face bias buff:

The cushion of a buff is the cloth between the outside diameter and the center diameter of the buff. In any given diameter of buff, the cushion size will decrease as the center increases. Obviously, as the cushion size decreases the buff life is reduced.

The alert buyer will insure that he is getting the buff life he needs by measuring the inside diameter of the center fastening ring to make sure it's the size he specified (3", 5", 7", etc.). An oversize center means an undersized cushion and less actual cloth content. The cloth content is the real measure of quality and value of a well-made bias buff constructed of cloth that meets requirements. And all one needs to determine it are scissors, ruler, and identification chart.

CORROSION PROTECTION OF MAGNESIUM

(*Continued from page* 45)

an increase of 20 total pounds (fuel, frame, etc.), slowing down the aircraft and detracting from its performance. New and better techniques for protecting

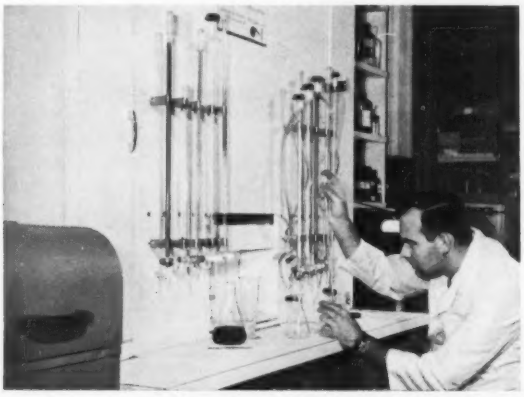


Fig. 12. A view of the volumetric control board for analyzing plating baths for magnesium. Exacting control is necessary for reproducible results.

Fig. 13. A view of the Great Arrow Chemical Laboratory showing the pilot plating line for magnesium.

magnesium will expand its use. Everyone will profit, from the basic producers to the final customer.

Magnesium is here to stay in electronic applications and it is up to everyone to see that it is tamed to serve.

Cycling Trends in Decorative Finishes are Turning Back to the Originals

By E. A. Zahn

STYLING trends, whether they be in contour, metal trim, color, or decorative materials, appear in regular cycles. For some of these styling trends, the cycles are pretty well known to us. For others, the trends are sometimes confused by the unexpected changes in marketing. If the market is unexpectantly off in a particular product category, the styling may change as much as two or three times a year to promote renewed customer interest. Normally though, restyling is done once a year and generally runs the regular cycle through contour, metal trim, and color. All producers concern themselves greatly with the competitive styling decisions and much spying is sometimes done. If one manufacturer, in a particular product line, plans a new product color series, his competitors will most likely do the same, but not necessarily in the same colors.

If the trend this year is towards box-like design with no rounded corners or bulged bodies, that trend will not usually appear again until new colors, decoratives, metal trim, etc., have all had their chance. On each trend cycle, a new buying public is of course involved. If the cycles are too close together, it is possible that color adoption or decorative finish adoption can injure sales rather than promote sales. The contour, color, and metal trim styling are basic and will always come back sooner or later as long as we can find new and appropriate names for them.

The Decorative Cycle

Decorative paints, such as the so-called "Hammers," the "Metallics," etc., have worn themselves out with time. A good example of this is "Wrinkle" finish, which has again found itself in minimum use.

Each decorative finish had a natural beginning. Many of these were quite by accident. The "Pearl" effect finish was one of the basic originals and may be a lone survivor among decoratives. The "Metallics," originally a substitute for "Pearl" are also wearing out. "Wrinkle" is going back to its basic use on instruments and instrument panels. The "Hammers" are too expensive to apply and like some other decoratives, cancel out all possibilities of high speed, high utilization, automatic application methods. All of the other textured finishes appear to be gradually diminishing to specialized use on low volume selling products.

There are of course, some new decorative materials and some of the more popular stand-bys which have not been materially affected by trends. These include the so-called, "Multi-Color" paints. For a time, it appeared that these would take over in view of their unusual hiding power in both color and in texture. Many users found them to be very useful and large volumes are presently in use. However, these multicolor paints appear to be more in the functional category rather than in the decorative category.

Other decorative paints which appear to maintain a hold to some extent are the textured and the spatter finishes, or, as they are sometimes called, "Leatherette" finishes. These are sometimes used in combination shades to produce a more pleasing effect. These are in the more functional category rather than in the decorative category.

Flock finishes, as such, are in a highly specialized category and their prime function is to imitate suede leather. There are definitely good and profitable applications of these but they are not usually classed among the decorative materials.

The other known decorative finishes such as "Crystals" and the "Veiling" finishes do not appear today in sufficient volume to consider them competitive in the decorative finishes field. The trends in application automation and high paint utilization have more or less caused these finishes to drop into the minority class.

The first and important purpose in styling trends, and in the selection of decorative finishes is to promote buyer interest. The "Metallics," the "Wrinkles," and the "Hammers," have now become too common

to attract sufficient new interest. With "Color," deeper impressions can be made on a potential buyer provided that the color is well and professionally chosen. The whole objective is to add "First Appearance Charm" to an otherwise common product to induce buyer interest.

The Deciding Factor in Product Design

The woman is still the strong deciding factor in product purchase decision regardless of the intended product end use. A woman's concept is important too, since she is a much more capable judge of appearance than a man. Uusually, a woman is more conservative in her selections than we give her credit for. She will admire the new and even the ridiculous deviations from the standards but not often to the point of buying. Woman's judgment, more than ever before, is determining the product finish styling of the immediate future.

Manufacturers are well aware of certain decoratives which are most pleasing to women. This is easily determined from the styling of the luxuries with which she surrounds herself. The trend in the women's selected niceties has been as radical as has all industry so far as appearance is concerned. It was found that, among the more popular niceties, were those items with the "Pearl" appearance. This has even migrated to the finger nails, lips, and eyes and sometimes even to the hair. The "Pearl" effect is apparently a very powerful basic attraction and some have predicted that it will be the new strong trend in our next decorator change cycle.

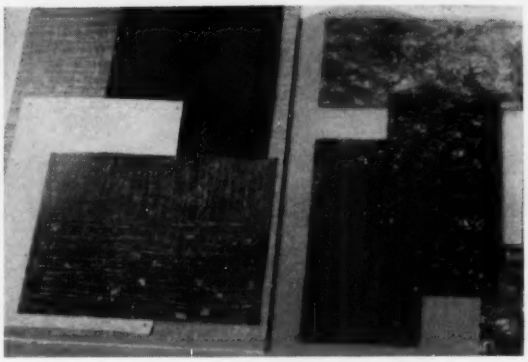
Real "Pearl" can be found of course on the more valuable small items in a household and particularly on the vanity table. In many instances, this "Pearl" finish is even more beautiful and amazing than real pearls. On the whole though, the synthetic "Pearl" will probably be the more important popular product used in the trades because of its lower price and being designed for high volume production use.

Industrial Applications for "Pearl" Finishes

Few people know that "Pearl" has already made appearances on products such as automobiles for some years now. This is particularly true of the special finishes for the automobile shows. It has been used over the metallics to enrich and to soften the harsher color tones and the metallic effects. There have also been rumors that some of the higher priced luxury cars are about to adopt "Pearl" as a production finish over-lay. The quantity of "Pearl" which would normally be used in automotive finishing is not the amount that would actually give a full "Pearl" appearance. It will be in an amount which will add definite richness to the more conventional finishes.

"Pearl" is now in regular use in the pre-finishing of plywood and good veneers. One popular new use is on prefabricated, wood, kitchen cabinets. Not the least of its uses is on hard-board, prefabricated wall panels. It has added a new richness to the otherwise common colors.

The predictions for "Pearl" now include such items as sewing machines, small and large appliances, etc. "Pearl" has always been the secret background of attraction on the otherwise, hard to sell musical instruments. It has also found strong acceptance as "Pearlized" upholstery in some of the higher class cars. It is very popular and credited with substantial sales increase in floor coverings.

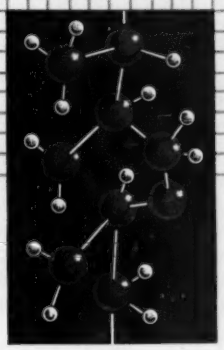


Typical Pearl Finishes

The rate at which "Pearl" will be adopted for new applications may be somewhat confused and probably somewhat slower than the "Metallics" for example. The reason for this slower adoption is because it need not necessarily be purchased, premixed, from the regular paint suppliers. Generally, the "Pearl" pigment paste is added by the user at the time of application and to suit his own tastes and standards. The more popular appearance "Pearl" finish is that which is achieved in a clear coat overlay finish on top of color. The less popular "Pearl" effect finish is that where the "Pearl" pigment is added to standard pigmented paints.

Until recently, most of us were of the opinion that "Pearl" effects should be applied only to surfaces having reasonable contours. However, the "Pearl" effect on flat surfaces, such as on a colored flat hardboard panel has been responsible for greatly increased acceptance of otherwise slow moving volume in those same standard colors. On an automobile, for example, when applied over black, the "Pearl" produces a sort of rich "Gun-Metal" color appearance having many times the richness attraction of the original color. When applied on an automobile over white, an immediate change takes place. Color warmth and richness, and new color life are added simultaneously. The product attraction value is raised to the highest possible level. Amounts of "Pearl" overlay, too small in quantity to be readily distinguished as "Pearl" add to the color attraction and the same colors are then much more desirable.

The manufacturers of "Pearl" compounds have already organized new laboratory facilities in preparation for the anticipated stepped-up "Pearl" buying trends. It is expected that the major volume of "Pearl" used will be negotiated between the paint users and the "Pearl" producers. The manufacturers of "Pearl" compounds prefer to furnish special resin base carriers, in paste form, for the different paint resin types.



SYNTHETIC RESINS

The Backbone of Modern Finishes

A SURVEY OF THE LATEST DEVELOPMENTS IN SYNTHETIC RESINS USED IN COATINGS

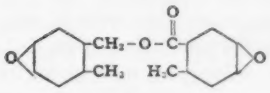
Part VI - Epoxy Resins (Section B)

By Harold P. Preuss

This is the second and concluding installment of Part VI (Section B) of this series on Synthetic Resins.—Ed.

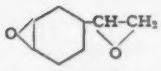
Union Carbide Resins

The Union Carbide Chemicals Company announced early last year the availability in commercial quantities of four cycloaliphatic "Unox" diepoxide compounds having the following structure:

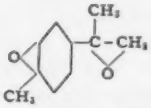


Unox Epoxide 201
3,4-epoxy-6-methylcyclohexylmethyl-3,4-epoxy-6-methylcyclohexane-carboxylate

Unox Epoxide 207
dicyclopentadiene dioxide



Unox Epoxide 206
vinylcyclohexene dioxide



Unox Epoxide 269
dipentene dioxide

These compounds are used as stepping stones in the formation of polymers having improved properties over conventional epoxy resins. The carbon-oxygen "triangles" are under great physical strain, and can be broken open by compounds having active hydrogen atoms (catalysts) such as amines, acids, phenols, alcohols, and thiols. Once the triangle is open, a chemical bond is available for reaction with other molecules, such as other epoxide groups (in other molecules), fatty acids, anhydrides, phenolic resins, and amino resins.

The outstanding features of Unox epoxide-based coatings are their non-yellowing and weathering characteristics. Spar varnish is optically clear on application, and its resistance to after-yellowing is excellent. The new coatings have also been adapted for linoleum use. They can be applied by doctor blade, brush, dip, spray, or roller coat. A one hour cure at 140°F. yields a durable, clear coating. Applicable by all conventional methods, these coatings are recommended for exterior or interior use on industrial and consumer metal products. They give excellent wear, abrasion, corrosion, and impact resistance, and can be made in many colors.

Unox Epoxide 206 has a viscosity nearly equal to that of water. It may be used as a solvent for many solid anhydrides, or as a diluent for conventional epoxy resins. In the latter function, it serves to increase the pot life of the resin mixture. An important feature is its economy.

Unox Epoxide 207 is a crystalline solid that melts at 363°F. It may be used as a starting material for protective coatings, fluidized bed coating, as well as for a number of uses not allied to protective coatings. It is of interest for heat resistant plastics.

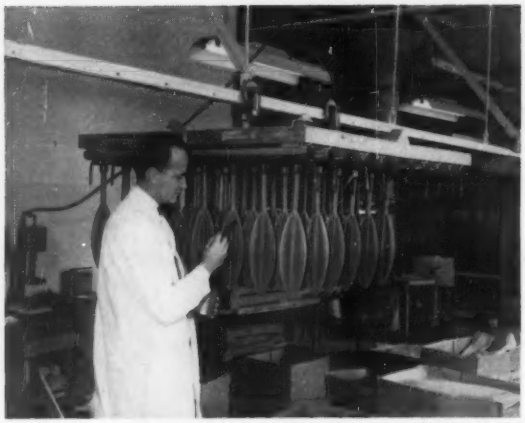
Unox Epoxide 201 provides polymers with low initial color and resistance to ultraviolet light, heat and air oxidation. It has a low viscosity. Its polymers, containing free hydroxyls, react with drying oils to form air-drying coatings. Combination with fatty acids gives varnishes of remarkable adhesion, alkali resistance, gloss and hardness.

Unox Epoxide 269 has shown most widespread utility as a reactive diluent for conventional epoxy resins. It maintains elevated temperature strength better than a mono-epoxide, but not quite as good as Epoxide 206. In addition to lowering viscosity, Epoxide 269 serves to lengthen pot life. It is potentially one of the lowest priced of all the presently known diepoxides.

A series of epoxy plasticizers have also been developed by Union Carbide Chemicals Company for incorporation in various coating systems. One of these is Flexol 163-D. Incorporation of this material in vinyl resin permits its use for coatings for house siding, etc. Another epoxy plasticizer, known as Flexol EP-8, provides vinyl products with outstanding heat resistance. Use of these plasticizers is extending to other chlorinated polymers and rubbers, chlorinated solvents, nitrocellulose and alkyd coatings.

The resins made by Union Carbide Plastics Company are known by the trade name: "Bakelite." This firm produces a number of epoxy resins, under this trade name, both liquid and solid.

Resin EKR-2002 is a solid resin that can be esterified with vegetable oil acids. A 75% solution of this solid resin in toluene is available and is known as *EKS-2002*. A 75% solution of the basic EKR-2002



(Courtesy Marblette Corp., Long Island City, N. Y.)

Fig. 2. Delays and downtime are reduced and rejects avoided in mass-production of beach balls by repeated immersion of aluminum mandrels in hot latex — thanks to the simple procedure of brushing an epoxy coating resin onto the metal forms. The protective plastic seals the pores of the mandrels, increases resistance to abrasion, and effectively inhibits formation of pits and fissures which would deform the finished products.

resin in xylene is marketed under the name *EKS-2102*. In general EKS-2002 can be used in place of EKR-2002 in formulas, and vice versa, provided allowance is made for solvents. EKS-2102 and EKS-2002 may also be substituted for each other in formulations. Properly formulated coatings having EKR-2002 as a basis exhibit excellent durability, toughness, chemical resistance, flexibility, and adhesion. Such finishes can be applied to a wide variety of surfaces by brushing, spraying, dip-coating, or flow coating. Surfaces that may be coated include steel, aluminum, zinc, tin plate, wood, masonry, molded plastic, and paper. Of particular interest are finishes for molded phenolic articles. Light tinted enamels, which have outstanding adhesion to these dark materials, are possible. Radio cabinets, telephones, and iron handles can be greatly enhanced in appearance by abrasion-resistant coatings based on EKS-2002. This resin is compatible with phenolic resins, urea-formaldehyde resins, and simple rosin esters. It is not generally compatible with alkyds and cellulose derivatives.

Solid Epoxy resin *ERRB-0100* (Novolac) * has been developed for use in the preparation of fluidized bed coatings. This is a highly epoxidized resin that contributes both rigidity and heat resistance to the fluidized bed coating.

Resin ERL-2774 is the most interesting of Union Carbide's liquid epoxies as far as coatings are concerned. It can be applied by brushing, trowelling, or spraying, depending on the formulation. The latter method, when properly executed, provides the most desirable means of application provided the pigmentation is not too great and the viscosity of materials is not too high. One of the oldest coatings use for ERL-2774 is as a stabilizer for vinyl resins. A typical such coating is used widely on bottle caps. Varnish manufacturers can prepare a range of epoxy resin esters using ERL-2774, "Bis Phenol A" and any chosen drying oil fatty acid.

Two other liquid epoxy resins made by Union Carbide are known as *ERL-2795* and *ERL-3794*. The chief differences between the three liquid epoxy resins can be found in their initial viscosity and in their performance after cure at elevated temperatures. ERL-2795, the least viscous of the three liquid resins, possesses good handling characteristics and performs well in room temperature applications. ERL-2774, which is more viscous, gives superior strength and electrical properties at elevated temperatures. Both resins exhibit good solvent resistance with ERL-2774 being slightly superior. The third resin, ERL-3794, is quite similar in most respects to ERL-2774, but has a slightly higher viscosity. It is recommended for applications requiring extreme solvent resistance. The three resins also differ slightly in their speed of reactivity, ERL-3794 reacting the fastest and ERL-2795 the slowest. Table 2 gives the properties of basic epoxy resins made by Union Carbide Plastics Company.

Reactive diluents such as butyl glycidyl ether or nonreactive diluents such as dibutyl phthalate may be blended with epoxy resins ERL-2774 and ERL-3794 to reduce their viscosity. Granular fillers such as silica and calcium carbonate may be dispersed in these resins and curing agents to modify their consistency, reduce the peak temperature reached during cure (curing mechanism is exothermic), and to increase the thermal conductivity and reduce the thermal coefficient of expansion of the cured resin system. Fibrous fillers such as chopped glass fiber or steel wool may be added to increase strength and impact resistance.

Six different modified aliphatic amine type hardeners are made by Union Carbide Plastics Company for epoxy resins. Table 3 shows the physical properties of these hardeners and Table 4 gives the pot lives of the various systems.

In last month's article on epoxies, reference was

*Epoxy resin derived from epichlorhydrin and phenol-formaldehyde.

TABLE 3

Physical Properties of "Bakelite" Liquid Hardeners

Properties	*ZZL-0814*	*ERL-2807*	*ZZL-0816*	*ERL-2793*	*ZZL-0812*	*ZZL-0803*
Viscosity, cps @ 77 deg. F.	2,500-4,000	3,000-5,200	200-400	5,000-13,000	30-40	90-130
Color, Gardener 1933	8 max.	10 max.	8 max.	10 max.	8 max.	6 max.
Specific Gravity	1.07-1.08	1.07-1.08	1.0-1.1	1.06-1.09	0.9650-0.9750	1.02-1.03

TABLE 4

Pot Lives* and Resin/Hardener Ratios for Various Systems

Hardener	*Parts by Weight Per 100 Parts Resin*	*Pot Lives, Minutes*		
		ERL-2795	*ERL-2774*	*ERL-3794*
ZZL-0814	25	12.5	11.5	10.5
ERL-2807	20	17	15.5	13.5
ZZL-0816	20	22	17	14
ERL-2793	25	22	19.5	17.5
ZZL-0812	22.5	44	32	30
ZZL-0803	37.5	Not recommended	80	60

*Pot Life of unfilled one-pound masses at 77 deg. F.

made to application of these resins by means of special two-component spray equipment, and one manufacturer of this equipment was mentioned, namely, A. Gusmer, Inc. of Woodbridge, N. J. In addition, Union Carbide has worked closely with other manufacturers of spray equipment in order to develop a system which would possess the following requisites:

1. Accurate metering and proportioning.
2. Ease of varying the proportioning ratio.
3. A method of viscosity reduction if required.
4. A method of providing a good resin/hardener mix.
5. A method of eliminating the pot life problem (clean out).
6. A method of developing a well atomized spray pattern.
7. High material spray rates, 100 pounds/hour or greater.

As a result the following equipment is now also available:

Binks "Turbulator" Spray Gun and "Formulator" Pumping Unit made by Binks Manufacturing Co., Chicago, Ill.

Spray Gun made by The DeVilbiss Co., Toledo, O.

Grayco Spray Gun and Pumping Unit made by Gray Company, Inc., Minneapolis, Minn.

Pyles Spray Gun and Pumping Unit made by Pyles Industries, Detroit, Mich.

Stuart Marine Spray Gun and Pumping Unit made by Stuart Marine Service, Stuart, Florida.

Minnesota Mining Resin

An epoxy resin flexibilizer and reactive diluent is marketed by Minnesota Mining and Manufacturing Company under the trade name *Cardolite NC-513.* This is a clear amber low-viscosity liquid that improves thermal shock resistance and impact without loss of chemical resistance. It combines chemically in any cured epoxy resin formulation. It is readily compatible with many aliphatic hydrocarbons. It finds use in the surface coatings industry in several ways: 1) by increasing coverage per gallon by reducing the amount of solvent loss; 2) it upgrades the ductility of low viscosity epoxy resins; 3) it reduces costs because smaller amounts of less expensive solvents can be used. This product cannot be considered a basic resin fully comparable to those mentioned in Table 2; thus it is not listed in the table.

General Mills Resins

The Chemical Division of General Mills, Inc. produces six basic epoxy resins. These are marketed under the trade name GenEpoxy. Three resins are of the liquid type and three of the solid type. Properties of the resins are given in Table 2. From these resins both air-dry and baking type industrial finishes as well as maintenance finishes can be formulated. Maintenance finishes have been proved successful on such difficult applications as corrosion protection of oil well rigging, internal lining of air slide railroad cars and for marine usage.

Solvent system coatings which have good solvent and chemical resistance, corrosion resistance and adhesion to many surfaces are formulated from *Resin 525.* This solid type resin can be dissolved readily in a number of solvents or is commercially available in solution form. The resin is mixed with the curing agent or coreactant just before use. Versamid polyamide resins act as coreactants with GenEpoxy resins to give coatings with excellent properties for multi-purpose chemical resistant films. These can be air dried or baked. Films from these resins are particularly noted for adhesion, toughness, and corrosion resistance.

With the development of liquid epoxy resins, 100% nonvolatile coatings systems become possible. These coatings have several obvious advantages. Industrial maintenance coatings can be applied as thick films to achieve maximum durability and corrosion resistance, decorative appearance, minimum application costs, and

(Courtesy Furane Plastics, Inc., Los Angeles, California)

Fig. 3. Epoxy coating used on submarine for underwater photography.

reduced fire hazard. In addition, these films, of course, cure without oxygen. Because of their low viscosities, liquid *Resins 175, M180, or 190* can be used for 100% solids coatings. Curing agents include aliphatic amines. Excellent results are also achieved with combinations of these resins and Versamid 125 and 140 coreactants.

Concrete surfacing formulations represent a specific type of 100% solids coatings. These are based on liquid *Resin M180* or *175* with Versamid resin plus sand.

When used with phenolic resins, solid *Resin 1800* produces baking finishes which have good chemical and solvent resistance, good adhesion, hardness, flexibility, abrasion and impact resistance. Unlike the amine and polyamide formulations, the Resin 1800-phenolic combination can be packaged as a one container system since it will not react at room temperature. This system has a very high degree of chemical resistance and is, therefore, useful for tank linings and similar applications.

Reaction of Resin 1800 with a urea-formaldehyde resin gives a coating which bakes to a hard, resistant finish possessing outstanding chemical resistance. This coating system is especially suited to baking enamels and primers for appliances.

The solid resins — *525, 925 and 1800* — can be esterified with various drying-type fatty acids for use in coating systems. However, *Resin 925* is especially suited for this application. Since the type of fatty acid used, the epoxy/acid ratio, and the curing cycle all affect the properties, it is possible to produce esters for a wide range of coatings applications. The GenEpoxy resin esters can be formulated into a one package coating system which dries rapidly to films with good chemical resistance and flexibility. Although the chemical resistance is not so great as for the amine cured or Versamid-GenEpoxy systems, it is superior to that of other one package systems such as the oil modified alkyd resins.

Other Manufacturers

The field of epoxy resins is growing very rapidly. The companies mentioned so far in this article, as well as those listed in foregoing articles, also make a number of specialized resins of the epoxy type, which space does not permit us to discuss. Some are solid resins dissolved in an appropriate solvent. Others are designed for use in encapsulating and vacuum impregnating electrical components. Still others are varnishes. Other companies, apart from those previously mentioned, have also joined the epoxy bandwagon. They may make copolymers with other resins from such starting materials as the Unox series described earlier.

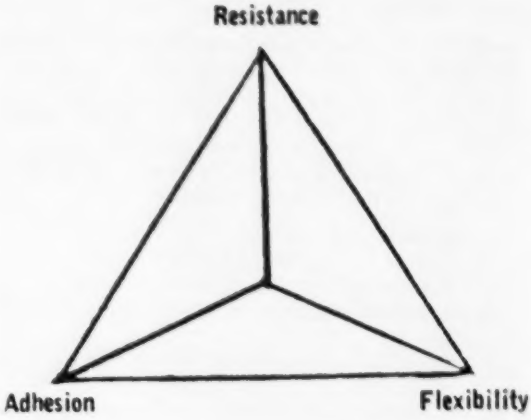
One point that should be stressed as regards the epoxy ester types of resin in particular is the almost limitless acidic components with which they can be reacted. These would include rosin and rosin derivatives, fatty acids, organic acids of many types, etc. All this permits a gamut of film properties such as flexibility, chemical resistance and adhesion.

Identification of Epoxy Resins

A simple laboratory procedure for identifying epoxy resins has been recently described.[4] A sample of resin in a micro test tube is heated to 240° to 250°C. in a glycerol bath. The open end of the micro test tube is covered with a disk of filter paper moistened with a freshly prepared water solution containing 5% each of sodium nitroprusside and morpholine. A blue color appears if epoxy resins are present.

Comparisons

If we were to take a triangle and plot the characteristics of various coating resins starting from the center, we may find some resins with better flexibility than the epoxies; we may find some that have better



specific resistances than the epoxies; we may even find a few that have better adhesion than the epoxies; but we will not find a resin which has all three of these properties in such a high degree simultaneously as do the epoxy resins. Any formulator with a difficult paint problem, involving adhesion, flexibility or resistance properties, must give some thought and consideration to epoxy resins for the job. Viewed in this light, then, is it any wonder that epoxy resins have enjoyed such a remarkable sales volume in spite of their relative costliness, special formulation and application techniques?

A report published early last year[5] compared exposure results of epoxy enamels, cured by various means, with certain other resins. Epoxy enamels tended to lose gloss more rapidly than the alkyds or oil-based coatings. Versamid-epoxy systems retained gloss a little longer than the amine-cured epoxy systems, while the epoxy ester coating was a little more gloss retentive than either of these. In whiteness after exposure, the results indicated the following order: alkyds, Versamid-epoxy and amine-cured epoxy, epoxy ester, phenolic oleoresin. The epoxy enamels were superior to the alkyd enamels in resistance to corrosion on long-term exposure.

In a corrosion resistant study with primers, the Versamid-epoxy primers gave superior performance. Second to the Versamid-epoxy primers in this test series was a vinyl resin primer containing zinc chromate pigment. It gave fairly good performance when tested on angle iron in the tidewater area, but was deteriorating noticeably after 24 months. This was a five-coat

(*Continued on page 56*)

Improving Convair's Finishes

By Thomas A. Dickinson, *Los Angeles, Calif.*

Test specimens are finished as illustrated here to determine what normal weather conditions are best for the application of different coating materials.

INFRARED spectrophotometers and environmental spray booths are currently being used by the Convair Division of General Dynamics Corp., San Diego, Calif., to facilitate the selection and application of finishes that will best serve the needs of tomorrow's aircraft, missiles, and space vehicles.

The spectrophotometers include both long and short wave instruments, and are said to be especially practical for the evaluation of coatings' heat and radiation resistance.

According to E. E. Keller, assistant supervisor of the firm's materials and processes laboratory, a complete and accurate analysis of any given coating can be obtained in about 15 minutes by placing a single drop of the material in an appropriate spectrophotometer and scanning the color breakdown that is obtained when it is subjected to infrared radiation.

Source of the radiation is a Nernst glower, or heating element comprising rare-earth oxides, and its output is broken down to a desired wave length in each instance by prisms made from ordinary rock salt.

Data for all spectrophotometer tests are detected and permanently recorded by means of thermocouples and scanners. Future reference thereto is expected to enable company engineers to select not only a type of coating, but an actual finishing product which can be relied on for best results where similar materials are obtainable from several different manufacturers.

To determine exactly how various finishes can be most satisfactorily applied, the firm has one 10′ x 10′ enclosed environmental spray booth in which temperatures can be varied from 40° to 100°F. along with humidities ranging from 20 to 90%.

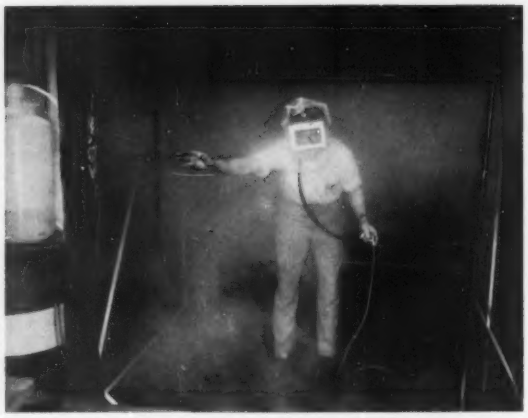
"Some finishes will not adhere properly and others, such as lacquers, will have a cloudy or unusual appearance if applied when atmospheric conditions are not just right," explains *J. C. George* of the paint, finishes, and corrosion laboratories. "It isn't economically practical to simulate ideal applicational conditions for all of our spray work. But by using one environmental booth, we are able to determine when ambient conditions elsewhere will permit the application of the best finishes with different coating materials."

Another environmental facility used by the company is a 12′ x 7½′ x 8′ salt spray booth with black polyethylene walls and a painted aluminum floor. It is used to spray a 20% saline solution, which creates an atmosphere that is about twice as salty as one normally existent above sea level, at temperatures up to 95°F. The temperatures are produced by two banks of 16,000-watt heat lamps, and with a saline spray they can create enough humidity in 50 hours to simulate the corrosive conditions a coating might encounter if exposed five years to severe outdoor weather.

One result of the coating research is a bright green acrylic coating which serves the sole purpose of protecting parts when they are being fabricated. This coating is relatively inexpensive and tough enough to prevent the scratching and corrosion of metal surfaces when they are being formed, drilled, riveted, etc., over a period of days, weeks, or even months.

Because of its aging characteristics, the green coating is not desirable in a permanent finish and, thanks to its distinctive hue, there is no possibility that it won't be removed and replaced with a more suitable material on final assemblies. Its removal involves simply the use of a commercial solvent such as acetone.

On aircraft like the new Model 880 jet transport plane, the company now makes extensive use of lacquers on internal surfaces which require durable decorative finishes; epoxy-type enamels on external



Wearing plastic hood, an engineer leaves heated salt spray booth after checking the condition of test specimens therein.

This is one of four infrared spectrophotometers now used to test coating materials.

surfaces which require maximal protection against various weather conditions.

In the production of future aircraft and missiles, company engineers believe, combined organic and inorganic finishes are going to be needed to prevent damage to external surfaces due to the high temperatures the surfaces will encounter in hypersonic flight. One combination that currently shows promise in this connection is glass fabric laminae bonded with a heat-resistant phenolic resin.

Experience with rockets, missiles, and earth satellites has already shown that many commonly-used coating materials may have practical applications in tomorrow's space vehicles. However, company engineers have expressed the belief that it will be necessary to obtain coatings which can serve as lightweight shields against deadly radiations before manned space ships will become practical.

SYNTHETIC RESINS

(*Continued from page* 54)

system over a wash primer. The amine-cured epoxy resin primers were inferior to the vinyl, and slightly better than the alkyd primers.

The unique properties of epoxy copolymer resins make them useful for an extremely wide variety of applications. These are summarized briefly in Table 5. In addition, work is going forward on epoxy acrylics, epoxy bitumins, epoxy mastics, etc.

However, epoxies are not miracle resins; coatings made from them cannot be expected to solve all coating problems under all application conditions. There are, indeed, many other families of resins which offer unique and interesting possibilities in the field of protective coatings. One of these is the acrylic family, which we shall discuss in the next article in this series.

References

(In addition to those quoted in Part VI, Section A)

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5. A Five-Year Exposure Study of Versamid-Epoxy Coatings. Official Digest, Federation of Societies for Paint Technology. January, 1960.
6. Literature supplied through the courtesy of Jones-Dabney Co., Division of Devoe and Raynolds Co., Inc.; Shell Chemical Co., Plastics and Resins Division; Union Carbide Chemicals Co.; Union Carbide Plastics Co.; Minnesota Mining and Manufacturing Co., Chemical Division; and General Mills, Inc., Chemical Division.

TABLE 5

Type of Finish	*Typical End Uses*
Epoxy-Phenolic	Can, drum, pipe and tank linings; wire coatings and impregnating varnishes.
Epoxy-Urea	Can linings; appliance primers; clear coatings for brass hardware, jewelry and vacuum metalized plastics; foil coatings; and coatings for laboratory and hospital furniture.
Epoxy-Amine	Linings for transmission pipelines; coatings for machinery, process equipment and structural steel in chemical plants.
Epoxy-Polyamide	Generally same uses as epoxy-amine finishes.
Epoxy Resin Ester (unmodified)	Overprint varnishes; primers for autos, appliances and other equipment; foil coatings; original and maintenance finishes for structural steel.
Melamine-Modified Epoxy Resin Ester	Generally same uses as unmodified epoxy resin ester finishes.

Current-Distribution Improving Aids*

By Robert H. Rousselot, *Electrolysis Laboratory, French National Center for Scientific Research*

Introduction

OBTAINING a metal deposit thickness as nearly uniform as possible on complicated shapes is one of the electroplater's important problems. There are two main areas in which the appropriate answer can be sought. One may act upon:

a) the bath composition and the operating conditions,

b) the field and the current distribution over the electrodes.

Considerable progress has been accomplished in the first area, which may be called Electrodeposition Chemistry, and it is now possible to find, for almost all platable metals, solutions containing surface active agents, chelating agents, brighteners, levelers, etc., having an excellent throwing power or leveling power. Chromium, perhaps, is the only exception, due to the special physical chemistry of its ions in aqueous solutions.

In contrast, research work in the second area, which we might call Electrodeposition Physics, is practically non-existent. In electrodeposition practice, the use of aids to improve current distribution is almost exclusively limited to auxiliary anodes and cathodes, and pertains more to craftsmanship than science. It was decided, therefore, to undertake a study of distribution aids with a view to bringing out the basic rules of their behavior and, thus, allow for a more extensive and rational use of those means, particularly in hard chromium where acting upon the solution seems impossible.

Due to the lack of previous studies on the subject, the problem had to be considered from the very beginning and confined to simple cases. The present study, therefore, is elementary in the mathematical sense of the word. It is only when sufficient fundamental data are available that it will be possible to cover more complex cases. However, it would be useless to study over-complicated cases, as any practical case will always differ more or less from cases that may have been treated previously. An elementary knowledge of distribution aids behavior will already constitute a valuable guide in the solving of practical problems.

Experimental

In studying the fundamentals of current-distribution aids it was decided:

a) To limit ourselves, initially, to a two-dimensional field, i.e. to a system of vessel and electrodes presenting a plane symmetry.

b) to choose a very simple case: a plane cathode symmetrically placed in the center of a rectangular vessel.

The methods used to obtain field plots and to determine primary current distributions along the cathode were the conducting paper methods. The latter having already been described,* no further reference to them will be made in the present article.

The case studied is represented in Fig. 1 where the plane cathode is placed in the center of the tank, the two long sides of which are plane anodes. The anode distance (50 cm) was chosen so that it represents flat equipotentials in front of multiple anodes in a standard 60 cm-wide tank.

As is known, the current distribution over this cathode is such that infinite current density and minimum current density obtain at each end, and in the center of the cathode, respectively. Taking advantage of symmetry axes, the model can be limited to one of its four quadrants. All illustrations, therefore, will only refer to the upper right hand quadrant. Fig. 2 represents the original field of equipotentials and current lines without distribution aids.

Experiments consisted in measuring, for each current-distribution aid and for a given set of dimension and position variables, the alterations brought about in the original current distribution along the cathode. As it was deemed impossible to present all current distribution curves obtained, it was decided to adopt, as a criterion, the i_{max}/i_{min} ratio of maximum to minimum current density** found on the cathode. However, a

*A paper presented at the Annual Conference of the French Hard Chromium Platers' Ass'n., Paris, May 13, 1960.

*Rousselot, R. H., Répartition du Potentiel et du Courant dans les Electrolytes, Dunod Ed., Paris, 1960.

**Integrated over a very small interval (5 mm).

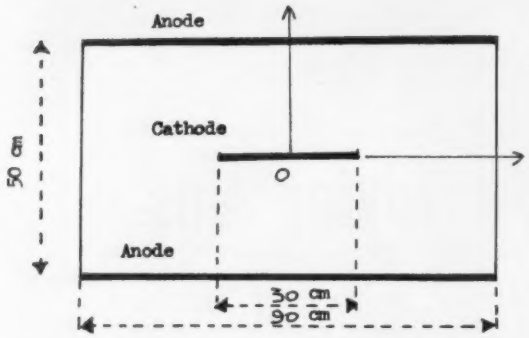


Fig. 1. Layout of anodes and cathode in the rectangular tank.

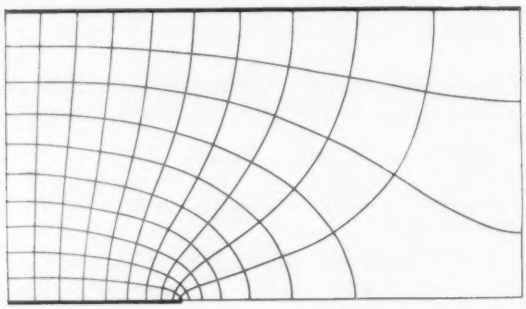


Fig. 2. Original field for the upper right hand quadrant of Fig. 1.

few typical distribution curves will be presented to clarify further the effects of distribution aids, along with the original current distribution curve, designated by A, for which the i_{max}/i_{min} ratio is 5.0. The typical distribution curves do not represent the best results obtained but, as their name implies, typical examples for the distribution aid concerned. A small sketch of the model is also included for easier reference. In addition, the curves plotted are cross-referenced in the tables by an asterisk.

At this point, two remarks have to be made:

1) The value of the i_{max}/i_{min} ratio acceptable in practice depends upon the nature of the solution used. Indeed, this ratio defines a primary current distribution, i.e. the distribution resulting exclusively from the geometry of the system. If the throwing power of the solution is good, one may accept a comparatively higher ratio and yet obtain a rather uniform metal distribution. If not, which is the case for chromium, the acceptable ratio should be as close to 1 as possible.

2) The ratio values presented here may be considered as pessimistic, as they correspond to an infinitely thin cathode which, of course, does not actually exist. Therefore, any plane cathode of finite thickness placed in an identical manner will present greater uniformity of distribution. The thin plane cathode, however, was retained in order to preserve the basic nature of this study.

Definitions and Results

The current-distribution improving aids can be divided into two types: a) the non-connected aids, which comprise shields, conducting shells and bipolar conductors; and, b) the connected aids, which consist of auxiliary anodes and auxiliary cathodes (robbers). In order to better understand the effects of such aids, the definition will be given in each case, together with the description of results.

1. SHIELD:

A shield is a thin insulating surface immersed in an electrolytic solution. As is well known, every perfectly insulating surface becomes a surface of flow or surface of current (a current line in a two-dimensional field). Consequently, when an infinitely thin shield is placed to occupy the position of a surface of flow, such as A′B′ on Fig. 3, the electrical field is not changed. However, when a shield is placed in any other manner, such as A′B′ on Fig. 3, the field will be modified so that the current lines run along the shield and make it a current line.

A shield may be used, a priori, in two simple manners:

a) parallel to the general direction of current lines to "channel" them perpendicularly to the cathode; and

b) perpendicular to the general direction of current lines (then parallel to equipotentials) so as to preclude current from reaching a given area on the cathode.

Figure 4 shows the effects, on the field pattern, of a small shield set perpendicular to the cathode end. Comparison with Fig. 2 demonstrates the straightening of current lines near the cathode and their more uniform spacing over it.

The results of current density measurements for per-

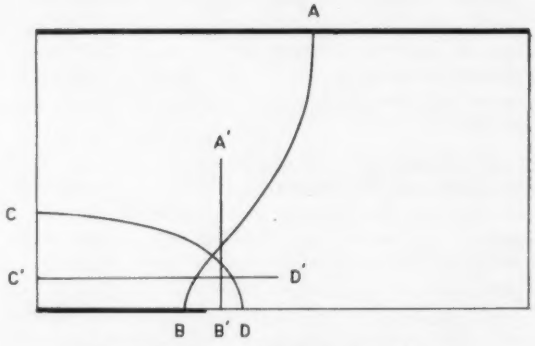


Fig. 3. Effect of shielding on electrical field.

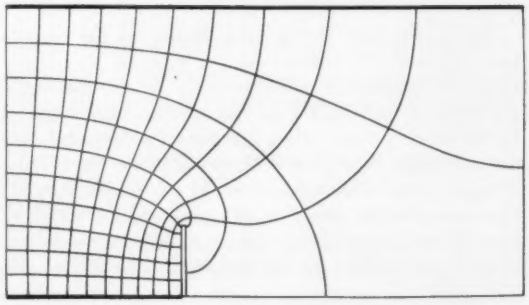
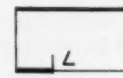
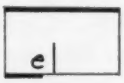


Fig. 4. Field pattern obtained with a shield perpendicular to the cathode end.

PERPENDICULAR SCREEN

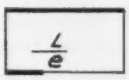


L	i_{MAX}/i_{MIN}
1	2.92
2	2.28
*4	1.62
6	1.31
10	1.12



e	i_{MAX}/i_{MIN}
0	1.12
0.5	1.76
1	1.89
2	2.30

PARALLEL SCREEN



e	L	i_{MAX}/i_{MIN}
1	2	3.14
	4	2.46
	*8	5.4
	16	50
2	2	3.95
	4	3.40
	8	3.18
	16	11.4
3	2	4.30
	4	3.87
	8	3.0
	16	5.7

Fig. 5. Current densities for perpendicular and parallel shields.

pendicular and parallel shields are given in the tables of Fig. 5. L is the screen length (in cm) and e the distance (in cm) between the screen and the cathode end. The asterisks refer to the current distribution curves plotted in Fig. 6.

The top left hand table shows the effect of increasing L for a screen perpendicular to the cathode end. The distribution improves considerably and for L = 2 cm only, the improvement is higher than 50% as compared with the original distribution.

However, when a 10 cm screen is moved to a distance e from the cathode end, the distribution deteriorates rapidly, as shown in the bottom left hand table. For example, a 2 cm screen against the cathode end is equivalent to a 10 cm screen, 2 cm away from the cathode end.

When a screen is placed parallel to the cathode and centered about its end (right hand table), the current distribution first improves and then deteriorates as L is increased for a given distance e. There exists, therefore, an optimum which depends on e. As the screen is moved away from the cathode, its length should thus be increased, but not beyond a certain value.

Typical current distributions along the cathode are plotted in Fig. 6. Curve A, as we said above, is the original distribution. Curve B, for a perpendicular screen, shows that the distribution is not only improved but smoother. Curve C shows a maximum at the screen entrance, followed by a minimum and a rapid rise due to the current reaching the cathode end.

In conclusion, a perpendicular screen is more efficient and more simple to apply than a parallel one. The latter, however, can be of some use when the above-described peculiarities can be put to advantage.

2. Conducting Shell:

A conducting shell is a thin conducting surface immersed in the solution. Any perfectly conducting material in an electrolytic solution is an equipotential. Therefore, if a conducting shell is placed to occupy the position of an equipotential, such as CD on Fig. 3, the electrical field is not changed, and the potential assumed by the shell is that of the equipotential over which it is placed (when the shell metal and the solution ions are identical). Furthermore, the side facing the anode will be negatively charged, whereas, the side facing the cathode will be positively charged. A conducting shell may thus be considered as a series of small dipoles placed side by side, which is precisely the definition of a shell. If the shell does not conform to an existing equipotential, such as C′D′ on Fig. 3, the field will be modified in such a manner that the equipotentials run along the shell.

A conducting shell is set parallel to the general direction of equipotentials to force the latter to be parallel to the cathode.

3. Bipolar Conductor:

A bipolar conductor is of the same nature as a conducting shell but is placed perpendicular to the general direction of equipotentials. By so doing, the bipolar conductor differs from the conducting shell in that it is now no longer the sides but the *end* facing the anode which becomes negative and the end facing the cathode which becomes positive. The bipolar conductor is used to force part of the current to reach a given area

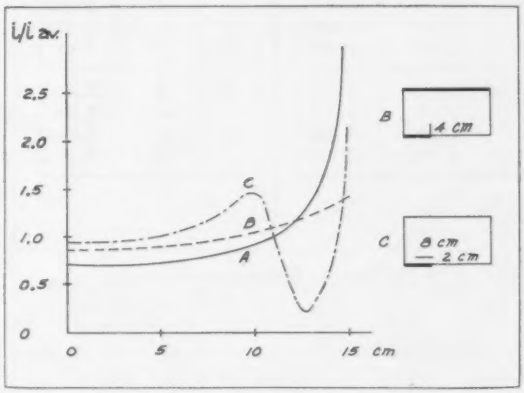


Fig. 6. Current distribution along cathode.

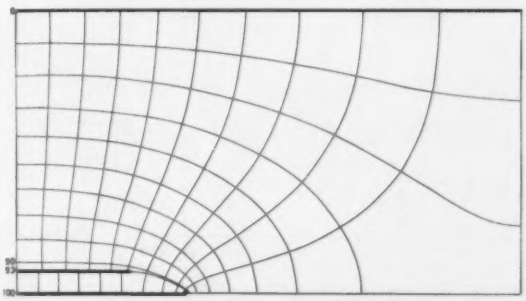


Fig. 7. Field pattern with conducting shell.

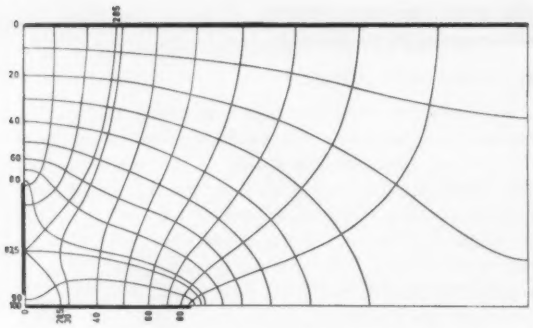
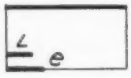


Fig. 8. Field pattern with bipolar conductor.

CONDUCTING SHELL



e	L	i_{MAX}/i_{MIN}
1	2	4.90
	4	4.90
	8	4.35
	15	2.05
1.5	2	4.40
	4	4.40
	8	4.30
	*15	2.45
3	2	4.30
	4	4.30
	8	3.90
	15	2.80

BIPOLAR CONDUCTOR

e	L	i_{MAX}/i_{MIN}
1	2	4.90
	4	4.90
	8	4.60
	15	4.30
2	2	3.80
	4	3.80
	8	3.70
	15	3.15
3	2	3.95
	4	3.95
	8	3.50
	*15	2.30

Fig. 9. Current density ratios on cathode.

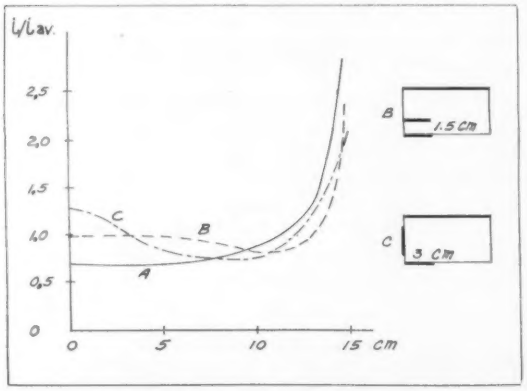


Fig. 10. Current distribution along cathode.

on the cathode. The expression "bipolar electrode," sometimes used, should be prohibited to avoid confusion with true electrodes (i.e. connected to a source of current).

(NOTE: On a conducting shell, as well as on a bipolar conductor, ions are discharged on the negative side and metal atoms become ions on the positive side. Therefore, there may be metal deposition on the negative side and dissolution on the positive side provided the metal is "soluble.")

Fig. 7 represents a conducting shell near the cathode. Potentials are expressed in comparison with 0 for anode and 100 for cathode. Note how the current lines are staggered and more uniformly distributed over the cathode; however, the effect does not extend far beyond the area "covered" by the shell.

Fig. 8 is a field plot with a bipolar conductor near the cathode. The bipolar conductor potential in this instance is 83.5. The equipotential line having the same potential is also represented. At the departure point of this equipotential on the bipolar conductor, current line 28.5 arrives from the anode and leaves for the cathode. This means that 28.5% of the current passes via the bipolar conductor to reach the cathode. At this singular point, current lines and equipotentials meet at 45° angles. The explanation for that peculiarity is given in the Appendix.

The current density ratios obtained on the cathode are given in the tables of Fig. 9:

a. *Conducting shell* (left hand table). For any of the three values for e, the distribution improves when L is increased. As e increases, the distribution improves when L is small, and deteriorates when L is large. As a general rule, a conducting shell has to be rather large and close to the cathode.

b. *Bipolar conductor* (right hand table). For any value of e, the distribution improves when L is increased. A larger portion of the current is diverted by the bipolar conductor to the low current density area on the cathode. As e is increased, the distribution improves when L is large, and presents an optimum when L is small. In general, a bipolar conductor has to be large with its end not too close to the cathode.

On Fig. 10 are plotted two typical curves: B for a conducting shell and C for a bipolar conductor, with curve A as the original distribution. B is rather uniform except at the cathode end, and C shows the amount of current thrown onto the low current density part of the cathode.

4. AUXILIARY CATHODE (ROBBER):

An auxiliary cathode is a conductor, usually of small cross-section, connected to the cathode and placed near a high current density zone. The potential of an auxiliary cathode being that of the main cathode, we therefore have a problem of multiple electrodes at the same potential, as described in the Appendix. It was generally accepted, until now, that the function of an auxiliary cathode was to "rob" part of the current to the detriment of the adjacent high c.d. zone. While it is true that an auxiliary cathode *is* a robber, the ef-

fectiveness of its action is ascribable to another phenomenon, as will be seen below.

Fig. 11 is a field plot with a 1 cm diam. wire, 1 cm away from the cathode end. Note the equipotential surrounding the two cathodes, with the singular point on the small current line between them. The current line from the anode to this point reveals the amount of current reaching the main cathode and the auxiliary cathode, respectively. But, far more interesting, is the fact that current lines to the main cathode are considerably straightened as compared to the original Fig. 2 and, apart from spacing, rather similar to Fig. 4. It then appears that the effect of an auxiliary cathode placed in this way is to force a current line to be perpendicular to the cathode end over a sizable length, rather in the same manner as a shield does. The comparable results with auxiliary cathode and screen are easily explained by the similarity of screens and current lines.

Fig. 12 represents a field plot with a wire auxiliary cathode at right angles from the cathode end. The singular point, where the equipotential surrounding both electrodes intersects with itself and with two current lines, enables us to determine how much current from the anode goes to the main cathode and to the auxiliary cathode. The left hand part on the anode, up to the singular current line, goes to the left part of the cathode; the center part, up to the second singular current line, goes to the wire cathode; and the right hand part on the anode goes to the right hand part of the cathode.

Fig. 13 presents the results of current density measurements with a 1 cm diam. wire connected to the cathode. The table on the left refers to a wire placed on the cathode axis at a distance e from the cathode end. The i_{max}/i_{min} ratio shows that the distribution deteriorates when the auxiliary cathode is moved away. Furthermore, the percentage of total current "robbed" increases. The right hand table indicates that, at an identical distance, a wire placed at right angles to the cathode end, a) results in a poorer distribution; b) robs more current.

Curves B and C, corresponding to the cases indicated by an asterisk in the tables, show that the axial case gives a rather smooth distribution, while the transverse case produces a deep minimum on the end third of the cathode.

In conclusion, an auxiliary cathode has a similar effect on current lines as a shield perpendicular to the main-cathode end, but robs a considerable portion of the current.

5. Auxiliary Anode:

An auxilary anode is a conductor connected to the anode and placed close to a low current density area on the cathode. The potential of an auxiliary anode being that of the main anode, we thus have again a problem of multiple electrodes at the same potential but, this time, far from each other.

An auxiliary anode may be made from a "non-soluble" metal, which is usually preferable, or from a "soluble" metal, which may entail important changes in shape.

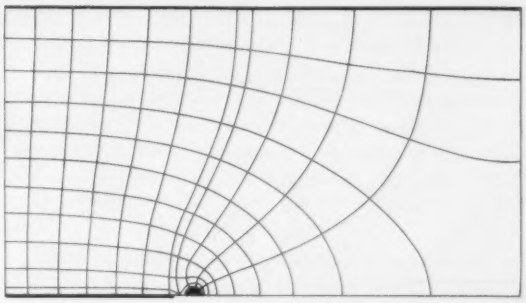


Fig. 11. Field pattern with auxiliary cathode set on main-cathode axis.

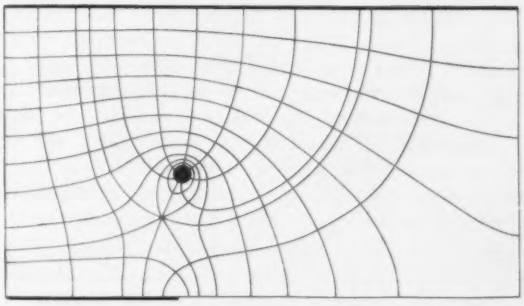
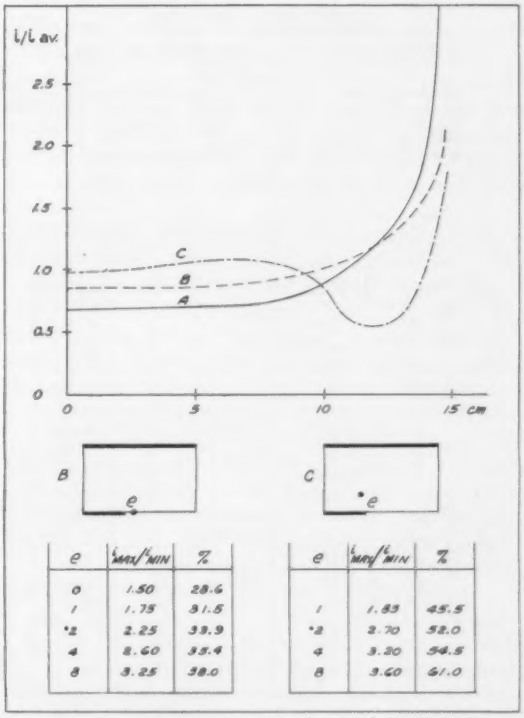


Fig. 12. Field pattern with auxiliary cathode set abreast of cathode end.



e	i_{max}/i_{min}	%
0	1.50	28.6
1	1.75	31.5
*2	2.25	33.9
4	2.60	35.4
8	3.25	38.0

e	i_{max}/i_{min}	%
1	1.83	45.5
*2	2.70	52.0
4	3.20	54.5
8	3.40	61.0

Fig. 13. Current densities with auxiliary wire cathode.

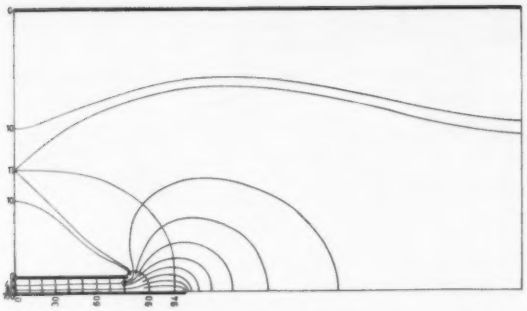


Fig. 14. Field pattern with auxiliary anode parallel to cathode.

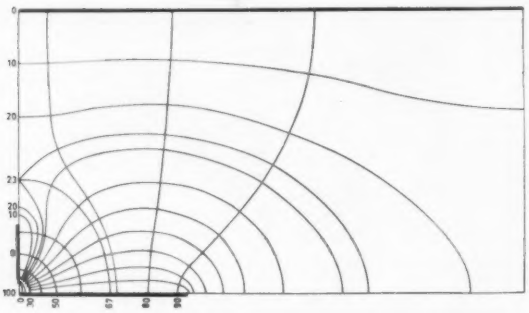
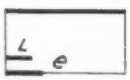


Fig. 15. Field pattern with auxiliary anode perpendicular to cathode.

AUXILIARY ANODE

PARALLEL



e	L	i_{MAX}/i_{MIN}
1	2	11.70
	4	10.60
	8	6.75
	15	1.80
1.5	2	6.05
	4	5.85
	8	4.05
	*15	1.58
3	2	3.2
	4	3.0
	8	2.3
	15	2.0

PERPENDICULAR

e	L	i_{MAX}/i_{MIN}
1	2	8.20
	4	8.00
	8	7.40
	15	7.35
2	2	4.00
	4	3.90
	8	3.75
	15	3.70
3	2	2.65
	4	2.60
	8	2.60
	*15	2.55

Fig. 16. Current densities with parallel and perpendicular auxiliary anodes.

On Fig. 14 is represented a field plot with an auxiliary anode parallel, and close, to the cathode. As can be seen by the relative potentials indicated on the left side, the whole potential drop (0-100) occurs over the very small interval between the auxiliary anode and the cathode. The left edge of the model is, of course, a current line where the singular point (potential 13) is located. The current line passing through this point is numbered 94. Looking at the current line numbers on the cathode, it can be seen that, in this instance, about 80% of the current comes from the bottom face of the auxiliary anode, 14% (from 80 to 94) from the upper face, and the remainder, 6%, from the main anode.

Fig. 15 is a similar case, with the auxiliary anode

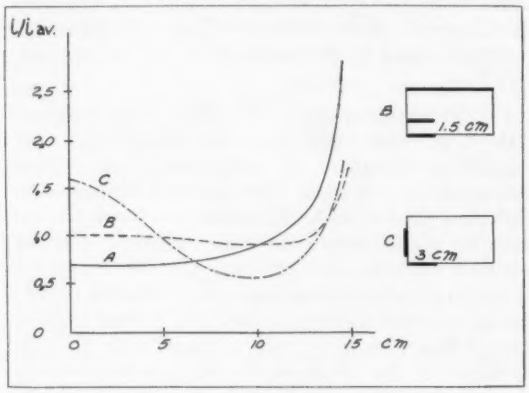


Fig. 17. Current distribution along cathode.

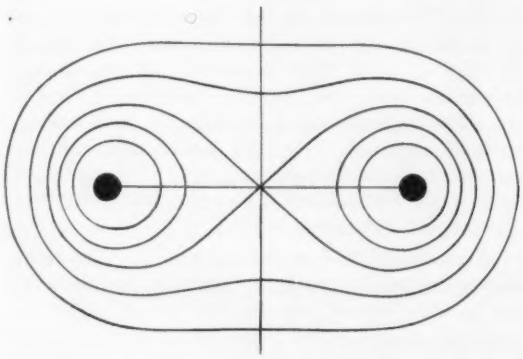


Fig. 18. Equipotentials around two electrodes at the same potential, with the counter-electrode at infinity.

perpendicular to the cathode in the low current density area. The potential of the singular point, in this example, is 23. Reading the current line numbers, indicate that 67% of the total current on the cathode comes from the auxiliary anode and the remainder, 33%, from the main anode.

Fig. 16 tables present the results of current density measurements:

a) *parallel anode.* For each value for e, the distribution improves when L is increased. As e increases, the distribution improves considerably when L is small, and varies slightly when L is large.

b) *perpendicular anode.* The distribution improves when either L or e is increased. The current density

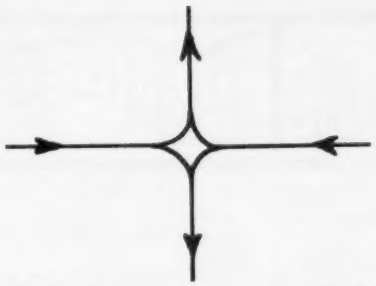


Fig. 19. Splitting of the symmetry current lines to the electrodes.

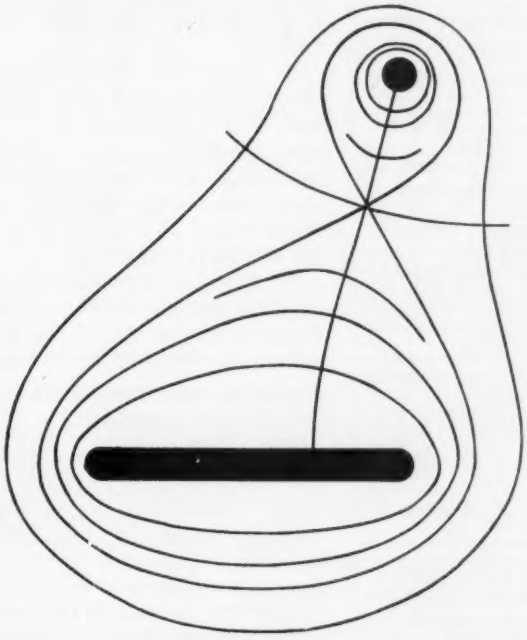


Fig. 20. Equipotentials obtained by extending one electrode (compare with Fig. 12).

Fig. 21. Equipotentials obtained by extending both electrodes in perpendicular directions (compare with Fig. 14 and 15).

ratio remains practically constant when the anode end pointing to the cathode is not too close (3 cm).

Fig. 17 presents two typical distributions corresponding to the asterisks in the tables. For the purpose of comparison, the values of L and e in those two examples of auxiliary anodes are identical to the values taken as examples for the conducting shell and the bipolar conductor (tables in Fig. 9 and curves in Fig. 10).

This comparison shows that curve B is more uniform when the conductor is made anode (Fig. 17) and that curve C is more uniform when the conductor is not connected (Fig. 10).

Conclusions

This elementary study enabled us to determine the specific behavior of each common distribution aid for simple shapes and single positions in relation to a simple cathode.

The qualitative and quantitative results obtained already constitute an excellent key to a more extensive and rational use of current distribution aids.

The continuation of this study, the long-term objective of which is the complete solution of current distribution problems on complicated three-dimensional electrodes, will cover the following points:

1) combination of elementary aids, with a plane cathode,

2) application of results to angular electrodes, and

3) study of "sources" and "sinks" of current, which ought to open a new era in the current-distribution improving technique.

Appendix

The equipotentials around two punctual electrodes at the same potential (interconnected electrodes), with the counter electrode to infinity, are curves called Cassinian ovals. When the potential difference between an equipotential and the common potential of the electrodes is small, the equipotential consists of two ovals, one around each electrode. When the potential difference is large, each equipotential encircles both electrodes.

There exists, between these two conditions, a singular eight-shaped curve, encircling each and both electrodes and intersecting with itself at the midpoint, called Bernoullian Lemniscate. (Fig. 18). The curve branches intersect, at this point, at right angles to each other. On the other hand, the line joining the electrodes and the axis of symmetry are current lines intersecting at the midpoint at right angles. Therefore, all angles around this point are 45° angles. The splitting of the symmetry current lines to the electrodes is represented in Fig. 19.

By extending the left electrode upward and by rotating the field plot, Fig. 20 is obtained, which helps to understand the lower part of Fig. 12, where a singular point appears between the two interconnected electrodes.

By further extending downward the left electrode of Fig. 18 and by extending the right electrode horizontally, a field pattern is obtained which, properly rotated, is represented on Fig. 21. The right hand half resembles Fig. 14 and Fig. 15 even more closely.

SHOP PROBLEMS

METAL FINISHING publishes, each month, a portion of the inquiries answered as a service to subscribers. If any reader disagrees with the answers or knows of better or more information on the problem discussed, the information will be gladly received and the sender's name will be kept confidential, if desired.

Crack-Free Chromium

Question: We have seen references recently to a crack-free, high temperature, high ratio chromium plating process, developed at Battelle Memorial Institute. Will you please furnish us with whatever information you can about this solution, and advise if it is practicable to convert our present set-up to take advantage of the greater corrosion resistance found for this type of deposit.

R. C.

Answer: The following solution is suggested:

Chromic acid	54-56 oz./gal.
Sulfate	0.35-0.36 "
Sulfate ratio	150-160:1
Temperature	130°F.
Current density	150-350 amp./ft.^{2}

The solution should have at least ⅔ oz./gal. trivalent chromium, which may be produced in the bath by cautious additions of small amounts of sugar to reduce some of the hexavalent chromium.

Brightest deposits are obtained at about 300-350 amp./ft.^{2} and a common plating time is 4-6 minutes. If the current available is sufficient for the higher current density, the rack capacity of the tank will not be changed, but there will be a small loss in production due to the longer plating time.

Gold Alloy Bath

Question: We would appreciate any data you can furnish, or any information as to where such data can be obtained, on deposition of an alloy of copper, nickel and gold. Also, if possible, could you advise us as to how we can vary the ratios of the constituent metals in the deposit, as a basis for our further experimentation?

N. N. L.

Answer: The bath composition and typical operating conditions are as follows:

Metallic Gold	1 g./l. (as potassium gold cyanide)
Metallic copper	12-20 g./l. (as copper cyanide)
Metallic nickel	30-50 " (as potassium nickel cyanide)
Free KCN	4- 8 "
Dipotassium phosphate-	30 "
Temperature	25°C.
Current density	20-60 amp./ft.^{2}

An increase in free cyanide, or decrease in current density, favors the deposition of the gold. The copper content increases with decrease in free cyanide and increase in current density and is not affected by the copper concentration of the solution to any great extent. The nickel content of the deposit ranges from 2 to 8% with changes in operating conditions. Hardness of the deposit is claimed to be as high as 200 Vickers.

Plating Leaded Brass

Question: We have an inquiry from a customer concerning cadmium plating on leaded brass and on free machining brass. They claim they frequently encounter trouble with poor adhesion. The leaded brass contains about 1.0% lead and the free machining brass contains about 3.0% lead.

Could you comment on this and also, do you think bright nickel would give them better adhesion?

L. S. W.

Answer: Results with leaded brass may be very erratic, due to segregation of lead globules in the surface, and smearing during machining or buffing.

After alkaline cleaning, parts should be dipped in a solution of 1 part fluoboric acid to 4 parts water. If this does not produce acceptable adhesion, a cyanide copper flash plate may be tried.

As a last resort, the use of a nickel chloride-muriatic acid strike on leaded brass often results in satisfactory adhesion. The solution consists of 2 lbs./gal. chloride and 1 pint/gal. acid, and is used at room temperature and 6 volts for ½-2 minutes. Nickel or carbon anodes are suggested.

We would not expect bright nickel to offer better adhesion than cadmium, probably less because of the greater stresses introduced by the former.

Cadmium and Zinc vs. Organic Finishes

Question: We are interested in getting information on the realtive corrosion resistance values of various types of plating, especially cadmium and zinc as compared to the other types of coatings as galvanizing, lacquering, and painting. If you have any publications, reports or can recommend any books on the subject, we would appreciate the information.

G. B.

Answer: Corrosion resistance values of cadmium, zinc, and organic finishes cannot be compared, as they serve different purposes. Cadmium and zinc are sacrificial metals and their protective action depends on their dissolving away. Organic finishes, on the other hand, protect by acting as a barrier to the corrosive environment.

Which type of coating is employed will depend on the specific requirements of an article. However, a cadmium or zinc coating, if bare basis metal is exposed, will offer protection, whereas, corrosion will occur wherever the basis metal is exposed through a paint film.

White Etch

Question: Can you inform us concerning the composition of a porosity test called a "White Etch" for nickel

plate? We have never come across this type of test and can find no references on it.

D. W.

Answer: The "White Etch" is not used for nickel plate, but is a porosity test used by some electronic firms for gold deposits. Parts are dipped at room temperature in a solution of 3 cc. water to which are added 50 cc. of a stock solution of the white etch (80 parts nitric acid and 20 parts hydrofluoric acid, 50% grade, by volume). After 15 seconds immersion, the parts are rinsed thoroughly and examined for removal of gold deposit.

Precipitate in Nickel Solutions

Question: We are forwarding herewith a sample of brown mud which has been clogging our filter very rapidly. The mud is from a bright nickel solution, which is air-agitated and filtered continuously. It looks like iron, but all our work is brass, and we know of no source from which iron could get into the tank. This leads us to believe that the precipitate is an organic decomposition product from the brightener, but our supplier denies this. What is your opinion in the matter? Since the mud is quite gelatinous, the filter must be cleaned out too often and becomes a serious production problem.

N. L.

Answer: The mud is soluble in dilute hydrochloric acid and gives a red coloration with thiocyanate, which indicates it to be ferric hydroxide or some other basic ferric salt. In a normal bright nickel solution, the iron impurity in the anodes dissolves in the ferrous form and is deposited out with the nickel quite rapidly since it is in the same family of elements. However, in air-agitated baths, the ferrous ions are oxidized to the ferric state and a precipitate is formed unless the operating pH of the nickel solution is very low.

The iron precipitation can be inhibited by adding small amounts of fluoboric acid when correcting the pH. Instead of cleaning out the filter, it is suggested that weak acid be circulated through it from a storage drum when the filtration rate drops excessively, followed by a water wash. This will eliminate most of the labor and downtime required to open the filter and clean off the mud.

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Science for Electroplaters

64. Nickel Plating - Watts Bath

By L. Serota

IN addition to the effect of the constituents of a Watts bath upon the nature of the deposit, such controllable variables as current density, pH, and temperature have a decided influence upon the cathode film and properties of the electrodeposits. These factors are interdependent.

Cathode Film

The effect of current density and temperature on the thickness of the cathode film in a Watts bath was found by S. E. Beacom to be directly proportional to the current density, and inversely proportional to the temperature. The study included two baths, A and B, with bath B containing, in addition to the constituents of bath A, two proprietary organic agents. Bath A consisted of nickel sulfate—40 oz./gal., nickel chloride—4 oz./gal., boric acid—4 oz./gal. and a proprietary wetting agent 0.65 fl. oz./gal. The two organic addition agents added to Bath B were of the alkyl sulfonate and quaternary ammonium salt types, respectively. Starting pH was 3.0.

Thickness of the cathode film was measured by the shadowgraph method (an optical method) which will cause concentration gradients at both anode and cathode when current is sent through a solution. The concentration gradient at the cathode will produce a corresponding refractive index gradient, resulting in an apparent cathode image (a dark band). The concentration of the refracted rays produces a bright band of light. The term "apparent thickness of the cathode film" is used for the width of the dark band, because of the complexity this method of analysis entails. Fig. 1 is a diagrammatic scheme representing the principle employed in the measurement of the film thickness. The (steel) cathode contained a 90 degree horizontal notch 0.005 inch deep across the midpoint.

Results indicated in Table I show a corresponding increase in film thickness, with increase in current density for baths A and B at 100°F. and 150°F., but a corresponding decrease (inverse ratio) in thickness at the higher temperature for each current density range.

For example, at a current density of 20 amp./ft.^{2}, the thickness of the film for bath A at 100°F. was 0.00291", but only 0.00220" thick at 150°F. The comparison for the inverse proportion of film thickness with temperature increase from 80°F. to 160°F., for cur-

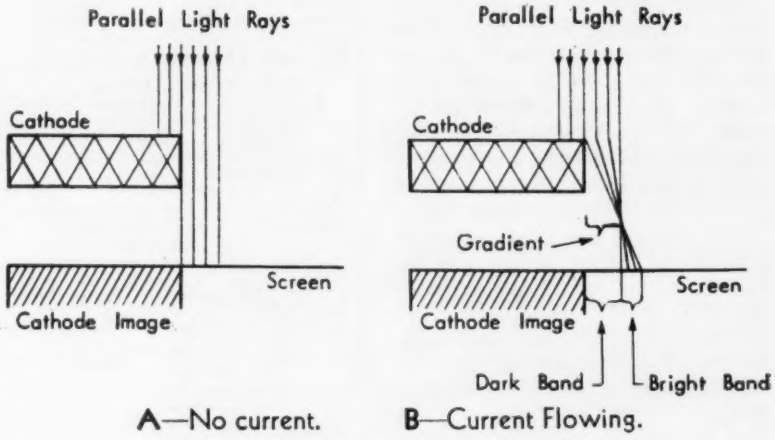


Fig. 1. Principle of film thickness measurement.

TABLE I

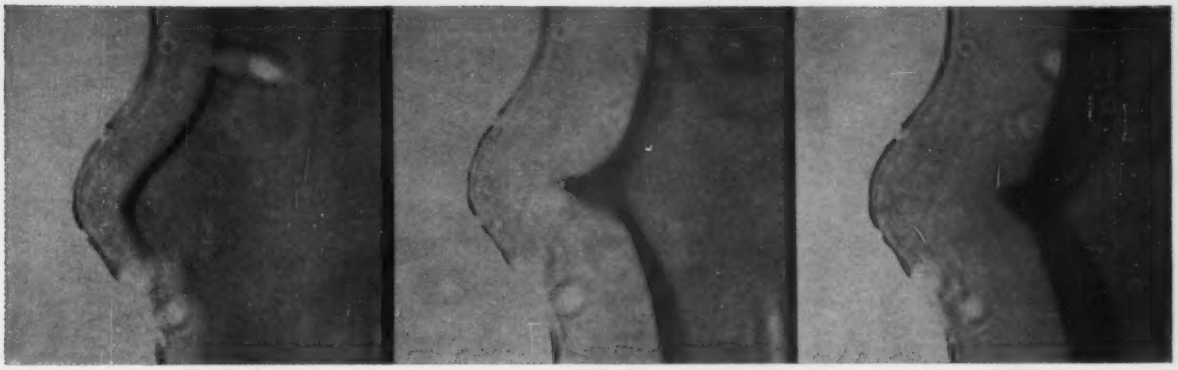
Apparent Film Thickness vs. Current Density

Current Density (Asf)	Bath A		Bath B	
	100F	150F	100F	150F
10	0.00291 in.	0.00220 in.	0.00248 in.	0.00232 in.
20	0.00570 in.	0.00426 in.	0.00618 in.	0.00426 in.
30	0.00650 in.	0.00488 in.	0.00670 in.	0.00488 in.
40	0.00690 in.	0.00552 in.	0.00725 in.	0.00559 in.
50	0.00690 in.	0.00556 in.	0.00733 in.	0.00591 in.
60	0.00710 in.	0.00579 in.	0.00764 in.	0.00618 in.

TABLE II

Apparent Film Thickness vs. Temperature

Temperature (°F)	Bath A		Bath B	
	Current Density 20 Asf	Current Density 60 Asf	Current Density 20 Asf	Current Density 60 Asf
80	0.00611 in.	0.00698 in.	0.00634 in.	0.00780 in.
100	0.00587 in.	0.00686 in.	0.00618 in.	0.00760 in.
120	0.00556 in.	0.00634 in.	0.00540 in.	0.00724 in.
140	0.00493 in.	0.00606 in.	0.00457 in.	0.00674 in.
160	0.00433 in.	0.00599 in.	0.00410 in.	0.00634 in.



(A) 150F, 20 asf (B) 150F, 60 asf (C) 100F, 60 asf

Fig. 2. Cathode films on notched cathode.

rent densities of 20 and 60 amp./ft^2 is indicated in Table II.

Additional evidence revealed in this study, regarding thickness of film at the flats and valleys of the notched cathode recorded in Table III, shows that the thickness in the valley is less than on the flat at 20 amp./ft.^{2} (0.00512″ on flat, 0.00788″ in valley; Bath A, 100°F.), but greater in the valley than on the flat at the higher current density, 60 amp./ft.^{2}. This result may be associated with the rapid decrease in metal ion concentration near the electrode surface which, in turn, requires a greater cathode film thickness for the supply of additional metal ions. This effect reduces the transfer rate of the agents to the valley. Lower polarization with increased metal deposition leads to leveling.

The per cent increase in the cathode film thickness from flat to valley at a current density of 60 amp./ ft.^{2}, indicated in Table IV, based upon values obtained in Table III, varies between the two baths; for Bath B it is about twice that obtained in A. For example, Bath A at 100°F. shows a 14.2% film thickness increase, whereas, for Bath B it is almost double, 27.5%. The value of 14.2% is derived from the data in Table III, as follows: 0.00788″ (100°F. valley) — 0.00690″ (100°F. flat) = 0.00098″ increase or 0.00098/ 0.00690 × 100 = 14.2%.

An interesting set of photographs of cathode film on notched cathodes made during these tests is shown in Fig. 2. The grey area represents the film. The black area represents the cathode, and the bright line the converged light rays. Mention was made that, in the photographs, plating operations during these tests modified the original 90 degree angle in the notch.

The effect of the variables, current

TABLE III

Apparent Cathode Film Thickness at Flat and Valley

	Current Density 20 Asf	Current Density 60 Asf
Bath A (Notch, 0.005 in.)		
100F Flat	0.00512 in.	0.00690 in.
100F Valley	0.00366 in.	0.00788 in.
150F Flat	0.00445 in.	0.00638 in.
150F Valley	0.00307 in.	0.00686 in.
Bath B (Notch, 0.005 in.)		
100F Flat	0.00548 in.	0.00698 in.
100F Valley	0.00441 in.	0.00890 in.
150F Flat	0.00445 in.	0.00654 in.
150F Valley	0.00386 in.	0.00760 in.

TABLE IV

Increase in Apparent Cathode Film Thickness from Flat to Valley at Current Density of 60 ASF

Bath	Temperature, °F	Thickness Increase, Per Cent
A	100	14.2
A	150	7.5
B	100	27.5
B	150	16.2

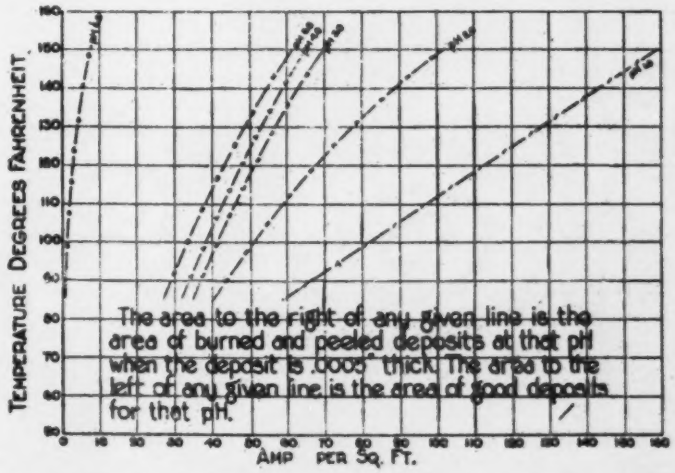

TEMPERATURE DEGREES FAHRENHEIT
AMP PER SQ. FT.
The area to the right of any given line is the area of burned and peeled deposits at that pH when the deposit is .0005" thick. The area to the left of any given line is the area of good deposits for that pH.

Fig. 3. Effect of temperature, current density and pH on characteristics of 0.0005 inch thick nickel plates.

density, temperature, and pH, upon the characteristics of 0.0005″ nickel plate deposited from a Watts bath (32 oz./gal. nickel sulfate, 3 oz./gal. nickel chloride, 3 oz./gal. boric acid) is shown graphically in Fig. 3. The wider range of current density permissible at lower pH, from which satisfactory deposits may be obtained under proper control of the variants, is clearly indicated. The graph shows, for example, that a good plate may be obtained at pH = 1 with a current density of 160 amp./ft.^{2} and temperatures up to 150°F. A pH range in between 1.5 and 2.0 may be used for a flash nickel deposit to give a smooth and adherent bright base plate.

Temperature

The structure of deposited nickel invites especial interest because, as J. B. O'Sullivan notes, in addition to its importance in plating, unlike other metals, such as copper, silver, zinc, lead, which are generally plated from acid solutions in coarse crystalline form, a nickel (acid) solution will deposit the metal in a finely crystalline form. A contributory factor to this condition is associated with the electropositive nature of nickel, resulting in some hydrogen being liberated as well as the deposited nickel.

The pH of the cathode film which will be higher, as a result of the released hydrogen, may result in the formation of nickel hydroxide, $Ni(OH)_2$, or a basic salt, with the probability that it would be deposited together with the nickel. Such co-deposits give either a smooth polish which may be brittle, or a dark spongy deposit, an effect similar to that produced by the presence of organic colloids.

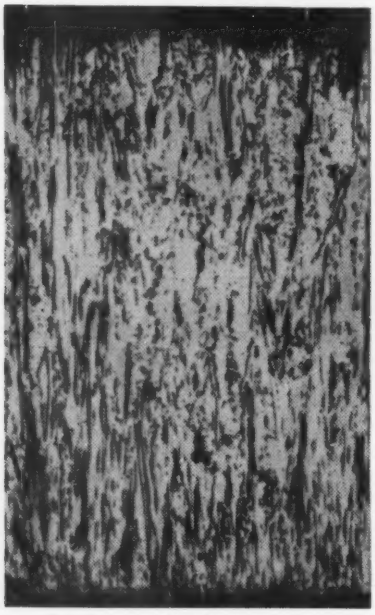


Fig. 4

Fig. 5

The nature of the deposit, accordingly, will vary appreciably with the conditions of deposition. This change in a Watts bath from a fine-grained columnar deposit at a low temperature (20°C., Fig. 4), to a conical and columnar coarse structure at higher temperature (55°C., Fig. 5), is evident. A pH of 3.0 and a current density of 46 amp./ft.^{2} was maintained for both temperatures. Brenner and Jennings also found that grain size from the Watts bath generally increases with thickness of deposit.

E. E. Heusner and associates refer to the conical structure as a variant of the columnar structure, with some of the grains growing larger in diameter with outward growth from the basis metal. D. J. McNaughton and A. W. Hothersall state that the surface appearance of a deposit may or may not indicate its micro-structure. A coarse columnar structure, they note, may be visibly crystalline, whereas, a finer micro-structure with small crystal facets would not be readily detected. Scattering of light rays, however, will give the deposit a matte appearance. Finer grains will result in a smooth surface with lustrous appearance.

pH

E. J. Roehl found that a gradual grain refinement of nickel deposited from a Watts type bath resulted with increase in pH. This is indicated by photomicrographs. Fig. 6 represents the structure of nickel deposited at a pH of 1.75 (130°F., 50 asf), Fig. 7 the structure of nickel deposited at a pH of 5.3 (130°F., 50 asf).

V. Zentner, A. Brenner and C. W. Jennings issued a report based upon their investigation that, at a current density of 46 amp./ft.^{2} (55°C.) little change in structure of deposited nickel occurs when the pH is varied from 1 to 5. A finer grain in the deposits, they found, results at pH of 5.5 to 5.7. The change (finer grain) is attributed to the inclusion of colloid basic material.

The relationship of pH to pitting in the Watts type bath, and its effect upon the deposited metal, was the subject of study by D. J. McNaughton and his associates. It was found that pitting occurs within the pH range of 5.6-3.0, with the maximum pitting intensity noted at a pH of 4.0.

Contrary to the view held that increased pitting will occur with decrease in pH, McNaughton found that pitting may be reduced to a minimum, if not eliminated, at a sufficiently low pH, whereas, pitting may occur at higher pH values. This effect is attributed to two conditions: first, the detachment of the gas from the cathode surface at a low pH becomes easier because of the rapid growth (size and buoyancy) of hydrogen bubbles, second, the rapid discharge of the gas at low pH, producing agitation, will aid in the more rapid dislodgement of the bubbles.

It was also observed that, although

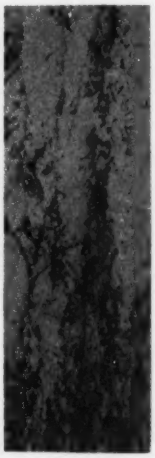


Fig. 6

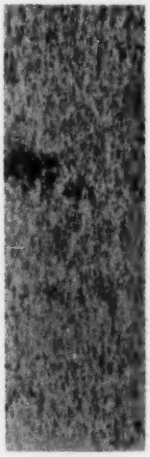


Fig. 7

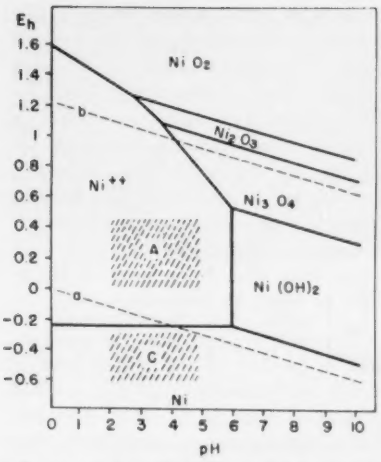


Fig. 8. Anode and cathode potential ranges.

considerable pitting occurred within the pH range of 4.2-3.4, this effect was lessened when the pH in the Watts bath was increased above 4.2, even though conditions favored a slower growth and reduced agitation of the hydrogen bubbles produced at the cathode. This state of maximum pitting in the pH range of 4.2-3.4 is associated with the formation, in increased amount at this pH range, of flocculated basic material in the area of the bubble at the cathode face, thereby aiding adhesion of the hydrogen bubble. F. Foerster and F. Kreuger suggest the presence of nickel hydroxide in this pH range at the cathode surface as an important factor in the degree of pitting.

In support of this view (flocculation) traces of precipitated matter appeared in pits, as well as black interiors found in some pits (more so in the pH range of 4.2-3.4), indicating partial reduction of the basic material. Flocculation of the colloidal matter and its effect in promoting pitting is attributed to the chloride in the Watts bath. The colloidal matter, positively charged, by depositing on the crystal faces contributes to fine grained deposits by restraining crystal growth.

W. C. Blum and C. Kasper found in their studies of electrodeposited nickel at high current density that pitting was eliminated when the solution at a pH of 2 or less was heated to the boiling point (102°C.). Pitting began to disappear around 90°C. With high pH, however, at high current density pitting occurred at times when the solution was heated to the boiling point.

E. B. Saubestre lists three methods employed for minimizing pit-formation: interrupting the plating operations in buffing or P.R.; introducing an oxidizing agent such as hydrogen peroxide, peroxysulfates, peroxyborates or nitrates; using a surface active agent. Aging of a nickel bath, it has been found, will give a more uniform deposit (microstructure) and less pitting than a new bath. This condition was confirmed by A. Brenner and associates in their study of nickel baths.

An interpretation by W. A. Wesley of the potential-pH relationship in a Watts nickel plating solution, at 55°C., in terms of anode and cathode reactions, by means of a Pourbaix chart, is indicated in Fig. 8. The solid lines indicate equilibria between various phases. For example, the line between the section including the shaded areas marked C and A represents the equilibrium between solid nickel and a solution of unit nickel ion activity at the potential (hydrogen scale) of —0.24 volt.

The electrode potential range, it will be noted from the chart, extends from 0.0 to 0.4 volt and —0.3 to 0.6 volt for the cathode, with variations in current density ranging from 1 to 100 amp./ft.^{2}.

In effect, electrodeposition of nickel will not occur under the conditions indicated by area A, and dissolution of nickel cannot take place under conditions limited to those included in area C. The dotted line, a, corresponds to the potential of the hydrogen electrode (1 atmosphere) and line b the potential of the reversible oxygen electrode at one atmosphere. A potential below line "a" will result in the liberation of hydrogen and a reduction in the efficiency of nickel deposition. When the potential is above line "b," anodic dissolution (efficiency) will be similarly reduced by the liberation of oxygen.

Deposition of nickel in the shaded area C is not, as would be expected, affected by excessive hydrogen liberation, because, Wesley believes, the pH of the cathode diffusion layer is higher as a result of hydrogen depletion, thereby approaching line "a" as the pH shifts to the right. This effect would cause a corresponding decrease in hydrogen release. Such condition, and not the fact that the overvoltage of hydrogen may be greater than that of nickel deposition, is considered the primary cause. Anodic corrosion, considering the distance of area A from the boundaries, should be quite satisfactory within the potential-pH range indicated.

(*To be continued*)

FOREIGN LITERATURE

Plating Low-Alloy Steels

Trouble-Shooting. O. Niedermeyer: *Metalloberflaeche* (Germany), **14,** No. 9, 285.

Difficulties which were encountered in nickel and chrome plating a low alloy steel (C. 0.22-0.29%; Si. 0.15-0.35%; Mn. 0.50-0.80%; Cr. 0.90-1.2%; Mo. 0.13-0.25%) made necessary a study of suitable treatments, to avoid defective production. The 12-15 micron coating sometimes peeled after only a few days, and it was clear that the trouble was caused by the pretreatment.

Initially, the pretreatment schedule was as follows:

A) Cleaning of the ground parts in trichlorethylene;

b) Final clean with Vienna chalk;

c) Cathodic cleaning with sub-coppering;

d) Rinsing;

e) Pickle in 10% sulfuric acid;

f) Rinsing;

g) Nickel and chromium plate.

Examination of the coatings that had lifted away showed that the sub-coppering had achieved no bonding with the basis metal. After various trials, a new pretreatment schedule was worked out, which gave perfectly good adhesion. This pretreatment was as follows:

a) Cleaning of the finish-ground parts in trichlor.;

b) Cleaning with Vienna chalk;

c) Anodic cleaning for 1 minute at 80-85°C.;

d) Rinsing;

e) Dip in 1:1 hydrochloric acid;

f) Rinsing;

g) Nickel and chromium plating.

The adhesion of the plated coating with this pretreatment, was satisfactory, but the hydrochloric acid dip was undesirable. In a further series of tests, a dip in 10% sulfuric acid solution was used instead, with retention of the anodic cleaning stage. The adhesion was entirely satisfactory in this case also. However, it was found at times that the adhesion of the nickel-

chromium coating, still left something to be desired.

As a great many brass parts with 2.34% lead were treated in the bright nickel baths, and it was suspected that this was causing the trouble. As these brass parts were hollow cylindrical bodies, only the outer surface being nickel plated, it was suspected that zinc and copper were dissolving into the plating bath. It was established in addition, that lead was also passing into solution, as a brown coating (presumably lead peroxide) was to be seen on the nickel anodes. Apparently, even this relatively small amount had a disturbing influence on the adhesion. The trouble was eliminated after a selective bath purification extending over several days. For production reasons, it was not always possible to nickel plate the steel and brass parts in separate bright nickel baths. The normal, continuous circulation purification however, did not suffice to remove the dissolved foreign metals. Accordingly, every other night the nickel baths were worked with corrugated cathodes at a voltage of 1-1.2. The metallic impurities present were thus removed to a satisfactory extent. With this and the above pretreatment schedules, no further adhesion troubles were encountered.

Progress in Electroplating of Bright Tin Coatings

S. C. Britton: *Metalloberflaeche*, **14,** No. 9, 277.

Details are given of the results obtained, with the bright tin-plating process developed at the Tin Research Institute. An acid stannous sulfate bath is used for the electrolyte, to which a dispersion of wood tar is added as the brightener, prepared from a suitable wood tar and sodium-n-octyl sulfate solution. Mirror-bright tin coatings are obtained in large-scale continuous operation. The bath composition is as follows:

Stannous sulfate	100 g./l.
Sulfuric acid	140 "
Brightener	80 cc./l.

Brightener addition must be carefully controlled, to obtain a high brilliance with low brittleness. The Hull cell test alone is not sufficient for bath control purposes, as the tendency towards the production of brittle deposits cannot always be ascertained with certainty by this means.

A number of large-scale platers already have this bath in operation. Bright tin coatings of greater thickness are obtained, than are possible by the fluxing process. Further, this process is suitable for parts, for which hot-dip tinning is not suitable.

The freshly prepared bath only produces a bright tin plate, when it has been worked for a certain time. A current throughput of 1 amp. hour/liter of electrolyte is normally necessary. With a bath in correct working condition, 2.5 to 6 amp./dm.^{2}, produces bright tin coatings. If the bath stands idle for a long period of time, it loses its brightening action. The electrolyte can be treated either with activated carbon and subsequently filtered, or else worked for a time with suitably shaped cathodes. Fresh brightener is then added. A bath which is continuously worked and, for example, is idle only during the week-end, can be kept in active operation for a very long time. The brightener becomes ineffective after a throughput of about 20 amp. hours/liter. When this has happened, about half of the volume of the brightener used initially is added. An addition of sodium-n-octyl sulfate solution, may also be necessary.

The bright tin coatings have the advantage of a pleasing color and, in addition, are not sensitive to fingermarking when wet. A further advantage is that, with the tin-flowing process, the coating normally cannot exceed 8 microns in thickness; usual practice is 5-8 microns. Accordingly, this bright tin process is usefully employed where thicker tin coatings are required. Coatings on steel or copper maintain a good appearance over long periods of time. A certain diffusion of the coating occurs when applied on brass and, accordingly, it is best to copper flash the brass before tin coating. The porosity of the bright tin coating is lower than with matte tin, whether the matte tin is subsequently flowed or not.

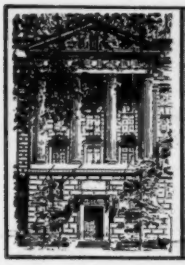
Trends and Problems in Bright Plating

E. Raub: *Metall* (Germany), **13,** No. 6.

Bright plated deposits are produced by a restricted or directed crystallization, for which certain added substances are responsible. These brightening agents or their decomposition products are bonded to the cathode by absorption and incorporated in the coating in more or less greater quantities. The influencing of the crystallization process, which occurs in this manner, causes lattice disturbances in the coatings and, as a consequence, a much increased hardness is often observed. At the same time, however, stresses are produced in the deposits which can be manifested in a tendency towards the formation of cracks and sometimes, also, by a lowered resistance to wear, by lamination, etc.

However, it is not only the mechanical properties of the plated coating which are influenced, but the chemical properties also. As to what effect this has on the corrosion behavior, has not been clearly explained. Tests have shown that bright nickel plate does not show any worse corrosion behavior during atmospheric exposure than a matte plate. Similarly, corrosion tests have shown that, with exposure to marine and land atmospheres, the corrosion resistance of bright plated coatings was found to be practically independent of the additions to the bath of brightening agents, addition agents for producing a leveling action, or to prevent the formation of internal stresses. In the same way, in the case of decorative bright chromium plate, no clearcut difference has been discerned with coatings on bright or matte nickel. The facts obtained, to a large extent however, are still controversial. The question of fissuring would appear to enter into the matter to a significant extent; the corrosion behavior would appear to be influenced by whether fissures are present or not.

Apart from this, coatings of bright nickel containing foreign substances, and with a strongly disturbed crystalline lattice, in general possess a greater chemical solubility than do plated coatings of matte nickel which consist of pure metal. The latter can rapidly be rendered completely passive by anodic polarization. Bright nickel remains completely active under the same conditions up to higher anodic current densities. The tendency towards passivation, accordingly, is much lower for bright nickel than for matte deposits. Certain differences in the corrosion behavior, particularly when it is a question of top coatings of fissured chrome or chrome which has other defects, accordingly, become quite understandable, in view of this fact.



Patents

RECENTLY GRANTED PATENTS IN THE METAL FINISHING FIELD

PRINTED COPIES OF PATENTS are furnished by the Patent Office at 25 cents each. Address orders to the Commissioner of Patents, Washington 25, D. C.

Spray Coating Machine

U. S. Patent 2,960,061. *Nov.* 15, 1960. *R. A. Whitbeck, assignor to Pennsalt Chemicals Corp.*

An apparatus for the purposes described and comprising means adapted to support stock for receiving a spray coating of liquid solution, a plurality of spray nozzles arranged for individual adjustment to different positions and to spray the liquid solution onto the stock while the stock is so supported, means for adjusting the spray pattern of each nozzle for a given rate of supply of solution to the particular nozzle, and flow control devices for the nozzles arranged to meter predetermined constant volumes of the solution per unit of time to the associated nozzles, independently of any fluctuation in the pressure at which the solution is supplied to the nozzles, whereby different metered amounts of the solution can be applied concurrently to different preselected areas of the stock, respectively.

Electrostatic Spraying

U. S. Patent 2,960,273. *Nov.* 15, 1960. *F. A. Croskey and C. D. Tuttle, assignors to General Motors Corp.*

An electrostatic spray painting apparatus.

Pickling Iron and Steel

U. S. Patent 2,959,555. *Nov.* 8, 1960. *R. C. Martin and W. T. Abel, assignors to The Dow Chemical Co.*

The method of removing a copper and iron oxide containing incrustation from a ferrous metal surface without redeposition of copper thereon which consists in bringing into contact with such surfaces an aqueous solution consisting of water in which is dissolved from 5 to 25 per cent by weight of hydrochloric acid, thiourea, and from 0.1 to 1 per cent of an organic nitrogen base other than thiourea capable of inhibiting the corrosive action of the acid on ferrous metal, the amount of the thiourea being in excess of 0.01 per cent by weight of the solution and between 2 and 20 times the weight of the copper to be removed, the volume of the aqueous solution being sufficient to remove the incrustations.

Regeneration of Spent Pickle Liquor

U. S. Patent 2,960,391. *Nov.* 15, 1960. *E. R. Sweet, C. A. Wolbach, Jr. and K. Sugino, assignors to Singmaster & Breyer, Inc.*

The method of treating spent pickle liquor comprising an aqueous solution of ferrous sulfate and sulfuric acid to concentrate the sulfuric acid and separate ferrous sulfate therefrom and thereby regenerate the liquor for use in pickling, which includes evaporating water from the spent pickle liquor to a concentration of ferrous sulfate slightly less than the concentration at which ferrous sulfate would be precipitated from the liquor and thus prevent precipitation of any ferrous sulfate and form a concentrated liquor, adding sulfuric acid to said concentrated liquor and thereafter evaporating water from the concentrated liquor causing ferrous sulfate to precipitate therefrom.

Agitated Cleaning Machine

U. S. Patent 2,960,991. *Nov.* 22, 1960. *M. R. Bland, assignor to Turco Products, Inc.*

Improved cleansing apparatus, comprising an upright receptacle forming an interior zone for receiving articles to be cleansed by liquid circulating therethrough, said receptacle having opposite sides at least one of which forms a recess opening transversely and divergently toward said zone, said recess being in the form of a truncated pyramid and said recessed sides flaring toward the top and bottom of the receptacle, and a propeller in said recess operable to draw liquid in a high velocity course of flow transversely from within the interior of said zone toward said recess and to return liquid in a high velocity course of flow transversely away from said recess toward the interior of said zone.

Nickel Leveling Agent

U. S. Patent 2,961,386. *Nov.* 22, 1960. *U. F. Marx, assignor to Wilmot-Breeden Ltd.*

A process for the electrodeposition of nickel comprising the step of electrodepositing nickel from an acidic aqueous solution of a nickel electrolyte containing dissolved therein a small proportion of a coumarin derivative selected from the class consisting of 6-sulphamidocoumarin, coumarin bisulphite, and salts thereof, 6-nitrocoumarin, 6-aminocoumarin and 6-acetamidocoumarin, said proportion being such as to confer enhanced leveling properties on said solution.

Porcelain Enameling

U. S. Patent 2,961,337. *Nov.* 22, 1960. *E. E. Bryant and V. R. Luster, assignors to Ferro Corp.*

In the process of preparing ferrous base metal for direct-on porcelain enameling in which the metal is subjected to a preliminary cleaning operation, the steps following said cleaning operation of heat-treating the ferrous base metal at a temperature of between about 1,000°F. and 1,300°F. long enough to oxidize from about one to four grams base metal per square foot of surface, and thereafter applying a porcelain enamel cover coat directly to the base metal.

Conversion Coating—Magnesium

U. S. Patent 2,961,358. *Nov.* 22, 1960. *F. P. Heller, assignor to Amchem Products, Inc.*

In the art of forming a chemical conversion coating on magnesium surfaces wherein the surface is subjected to the action of an aqueous acid solution consisting essentially of hexavalent chromium and the anions of mineral acid from the class which consists of hydrochloric and nitric acids; the method which includes the following steps: preparing a bath of the said solution which contains, per liter, from 15 to 25 grams of hexavalent chromium, from 20 to 160 grams of chloride and from 0.8 to 1.5 grams of nitrate expressed as $NaNO_3$ for each gram of chloride; heating the bath to from 60° to 100°F.; applying said

bath to the surfaces to be coated until a visible film is produced thereon; and replenishing the bath as required, during use, so as to maintain the acidity thereof which is titratable with caustic to the Brom cresol green endpoint, at from 0.4 to 1.0 N.

Localized Plating Method

U. S. Patent 2,961,395. *Nov.* 22, 1960. *J. J. G. Icxi.*

A portable manually operable plating device comprising a body of electrical insulating material providing a handle and having a pair of forwardly extending tubular arms, electrical conducting members mounted in each of said arms and each having a passageway provided therethrough, a shaft of current conducting material connected to and extending between said conducting members and having passageways in communication with said conducting member passageways, a current conducting roller rotatably mounted on said shaft, absorbent material mounted on said roller for holding the plating electrolyte, means for connecting said conducting members to a source of electrical current and a pair of tubes each connected to one of said arms for connecting same to a supply of a coolant under pressure.

Electrostatic Spraying

U. S. Patent 2,961,581. *Nov.* 22, 1960. *G. Grave, H. Wegner and H. Gilles, assignors to Schweitzer Electrostatic Co.*

In an electrostatic-spraying equipment, means for supporting an article to be coated, and means to support a spray head, said head comprising a disk lying in a general plane parallel to the general plane of the article to be coated.

Printed Circuits

U. S. Patent 2,961,746. *Nov.* 29, 1960. *H. T. Lyman, assignor to Aladdin Industries, Inc.*

In a method of making a printed circuit, the operations comprising the provision of a thin flexible conductive backing plate of stainless steel, applying a thin cement coating of pressure sensitive cement to one side of said backing plate, applying a resist coating of photo-sensitive material hardenable by exposure to light over said cement coating, exposing an image area of said resist coating in a predetermined pattern to light while leaving the remaining non-image area unexposed, said resist coating thereby being hardened in said image area, applying a solvent to said resist coating and thereby dissolving away said resist coating and said cement coating in said non-image area, voids thereby being left in said resist coating and said cement coating in said non-image area, electroplating metal onto said plate and thereby filling said voids with said metal, said metal being of a material different from and substantially non-adherent to stainless steel, peeling said backing plate away from said resist coating and said metal in said voids while leaving said metal and said coating intact in adherent relation to each other, and subjecting said peeled resist coating and metal to an etching agent for a limited time to remove any stainless steel remaining adherent to said resist coating and said metal without removing any substantial portion of said metal.

Automatic Spraying

U. S. Patent 2,961,990. *Nov.* 29, 1960. *Q. L. Wruck, assignor to Allen-Bradley Co.*

A spray control operatively associated with means for moving objects to be coated past a spray station and normally inoperative spraying means positioned to deliver coating material within a predetermined coating area so as to coat objects moving therethrough.

Plating Machine

U. S. Patent 2,962,125. *Nov.* 29, 1960. *J. V. Davis, assignor to The Udylite Corp.*

Lift apparatus for an electroplating machine of the type having a frame and a chassis slidably mounted upon said frame for vertical travel relative thereto.

Gas Plating

U. S. Patent 2,962,391. *Nov.* 29, 1960. *G. A. Samuel, J. V. Bell and J. G. Jackson, assignors to David Craven.*

The process of chromizing ferrous metal articles, which comprises placing the articles in a closed space containing chromium and between 0.1 and 2 per cent of hydrazine hydrohalide on the weight of the charge and heating the articles, the chromium and the hydrazine hydrohalide to a temperature of 1600 to 2300°F. while surrounding the articles by a gas atmosphere evolved from the hydrazine hydrohalide and maintaining the articles at a temperature within the temperature range set forth for a time of at least 30 minutes.

Paint Stripper

U. S. Patent 2,962,395. *Nov.* 29, 1960. *L. J. Brown, assignor to Pennsalt Chemicals Corp.*

A paint stripping composition for use in aqueous solution consisting predominantly of 50-96% by weight of a caustic alkali, and minor amounts of a gluconate and an alkyl aryl sulfonate having the formula R—Ar—SO_3X wherein R is at least one alkyl group having a total number of carbon atoms of from 1-5, Ar is an aryl group of the group consisting of benzene and naphthalene groups and SO_3X is one of the group consisting of sulfonic acid and its salts.

Plating on Stainless Steel

U. S. Patent 2,962,427. *Nov.* 29, 1960. *L. K. Kosowsky, assignor to Columbia Broadcasting System, Inc.*

An electroplating process comprising etching a stainless steel article in a sulfuric acid etch solution in an electroplating tank while the article is a cathode, upwardly displacing the sulfuric acid etch solution from said tank by flowing into said tank a strike solution containing copper ions and having a specific gravity greater than the specific gravity of the sulfuric acid solution, and striking the cathodic article with the copper ions.

Chromium Bath

U. S. Patent 2,962,428. *Nov.* 29, 1960. *F. Passal, assignor to Metal & Thermit Corp.*

An aqueous bath for chromium plating comprising between 50 and 600 g./l. of chromic acid and at least one complex ion selected from the class consisting of fluo-aluminate, fluotitanate and fluozirconate ions, the ratio of chromic acid to said complex ion being between 50:1 to 200:1.

Wire Polishing Machine

U. S. Patent 2,962,742. *Dec.* 6, 1960. *F. N. Rushton, J. M. Mead and G. T. Jones, assignors to Washington Aluminum Co., Inc.*

An automatically operated apparatus for polishing continuous articles

passing therethrough, such as electrolytically coated wire, rod, or the like to impart a high lustre to the external surface thereof.

Belt Polisher

U. S. Patent 2,962,842. *Dec.* 6, 1960. *R. F. Pendergast, assignor to Northwestern National Bank.*

In an abrasive machine, a frame structure and means on said frame structure for supporting and feeding a workpiece in a given direction.

Corrosion Preventive

U. S. Patent 2,963,439. *Dec.* 6, 1960. *J. F. Eberhard, assignor to The Dow Chemical Co.*

A metal corrosion inhibiting composition comprising one part by volume of propargyl sulfide and from 0.25 to 1.0 part by volume of a sulfur-containing compound selected from the group consisting of ethanedithiol, thiolacetic acid, mercaptoacetic acid, ethyl sulfide, hydrogen sulfide, and ferrous sulfide.

Automatic Barrel Plater

U. S. Patent 2,963,140. *Dec.* 6, 1960. *J. Barton, assignor to Frederic B. Stevens, Inc.*

Conveyor apparatus for tumbling a mass of relatively small workpieces and for transferring said mass from one work station to another along a predetermined path.

Barrel Finishing

U. S. Patent 2,963,280. *Dec.* 6, 1960. *V. Bakalar and L. Zenisek, assignors to Kovo-Finis.*

A loading and discharging device for surface finishing machines.

Spray Silvering

U. S. Patent 2,963,383. *Dec.* 6, 1960. *A. R. Weinrich, assignor to Kay Chemicals, Inc.*

A process of spray silvering which comprises continuously flowing a stream of concentrated reducible silver salt solution, continuously flowing a stream of concentrated reducing solution at substantially the same rate as said stream of silver salt solution, continuously flowing a stream of carrier and diluent water in a volume of from 10 to 100 times the volume of said silver salt solution, co-mingling all three streams to produce a mixed stream containing water, reducible silver salt solution and reducing solution in a state of reactivity such as to deposit silver in a uniform dense layer upon the spraying of said mixed stream onto a support, and spraying said mixed stream onto said support.

Hot Dip Aluminum

U. S. Patent 2,963,384. *Dec.* 6, 1960. *C. J. Owen, assignor to Hubbard and Co.*

A method of coating a ferrous metal object comprising the steps of preparing a fused salt bath composed by weight of:

	Per cent
NaCl	35 to 55
KCl	35 to 55
Na_3AlF_6	5 to 20
K_3CrF_6	0.2 to 5

maintaining said fused salt bath at a temperature in the range of 1275°F. to 1400°F., preparing a bath of molten metal of a class consisting of aluminum and of aluminum base alloys, immersing the ferrous metal object into said fused salt bath thereby to flux the surface of the object, transferring the fluxed ferrous metal object immediately from said fused salt bath into said molten metal bath thereby to coat the object with said molten metal, and removing the coated object from the molten metal bath to ambient temperature for solidifying the coating to the surface of said object.

Tumbling Barrel

U. S. Patent 2,964,300. *Dec.* 13, 1960. *J. A. Lisowski, F. B. Lisowski and L. E. Lisowski, assignors to Natural Products Co.*

A tumbling holder for processing small parts comprising a pair of independently rotatable segmental cylindrical baskets having portions adapted for overlapping each other alternately on opposite sides, and when thus overlapped on one side leaving a relatively large open angular segment between their opposite sides, each basket being in fixed axial relation to the other and having one of its bounding sides of greater radius than the other and means for intermittently and alternately rotating each of said baskets in one and the same direction through a partial revolution about a common horizontal axis with an interval of rest between successive movements of each basket during which it is in supporting position for the work therein, each basket during its movement shifting the overlap from one side to the other thereof with the open segment always above the work.

Flexible Anodic Coating

U. S. Patent 2,963,409. *Dec.* 6, 1960. *E. R. Ramirez, assignor to Reynolds Metals Co.*

The method of forming an anodic coating of high flexibility and dielectric strength upon an aluminum surface which comprises immersing the aluminum as anode in an aqueous acid anodizing electrolyte consisting essentially of a mineral acid and from about 0.1% to about 10% by weight of a metal halide selected from the group consisting of alkali metal and alkaline earth metal halides and from about 0.2% by weight to a percentage represented by the limit of its solubility therein of an aliphatic dicarboxylic acid of from 2 to 5 carbon atoms, and passing a current through said electrolyte at a current density above about 200 amperes per square foot.

Conversion Coating — Zinc

U. S. Patent 2,964,432. *Dec.* 13, 1960. *H. T. Francis and F. H. Roebuck, assignors to National Steel Corp.*

A process for treating material having a zinc surface to improve corrosion resistance comprising immersing the material in a body of treating solution consisting essentially of an aqueous solution of zinc nitrate and chromic acid having a molar ratio of zinc nitrate to chromic acid between 4:1 to 1:9 to produce a corrosion resistant film on the zinc surface, the solution being free of a substance which is a reducing agent for chromate ion, at least the zinc surface of the material to be treated being initially at a temperature substantially above room temperature and less than about 450°F., removing the treated material from the body of solution, and then subjecting the treated material to an aqueous rinse to remove excess treating solution and produce a substantially colorless corrosion resistant film on the zinc surface.

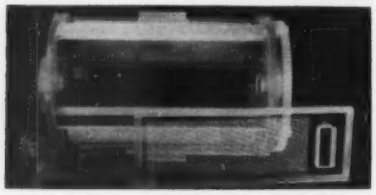
Electroplating Machine

U. S. Patent 2,965,110. *Dec.* 20, 1960. *D. J. Borodin, assignor to Wagner Brothers, Inc.*

A machine for conveying work pieces with an intermittent motion along a generally straight path by means of rail supported carriers.

Portable Plastic Barrel

National Plastics & Plating Supply Co., Dept. MF, Box 34, Terryville, Conn.



The Napco portable plater, a plastic plating barrel, features a non-warping non-breakable melamine door, positive grip snap-on plastisol covered clamps, all solution polypropylene drive gear; plastisol coated tie rods and motor mount rods, and a body re-inforced with H. T. Lucite.

Other features claimed for the barrel are heavy duty danglers, an oversize heavy duty clutch to permit positioning of the barrel while loading or unloading, and an optional forward and reverse switch.

Zinc Brightener

Metal & Thermit Corp., Dept. MF, Rahway, N. J.

A new liquid brightener for zinc plating baths, Zinc Brightener 25 is a free-flowing liquid that may be added directly to plating baths without prior dilution.

The brightener is exteremely useful for applying a uniformly bright zinc plate to low-current-density areas such as recesses and threads.

Spray Wash Cleaner

Enthone, Inc., Dept. MF, 442 Elm St., New Haven 8, Conn.

Sprean 66 is a powdered, alkaline product for spray wash cleaning of steel, copper, brass, and aluminum, formulated to provide maximum detergency, eliminate excessive foaming, inhibit steel parts and equipment from rusting, and prevent scale formation on spray nozzles and heating coils.

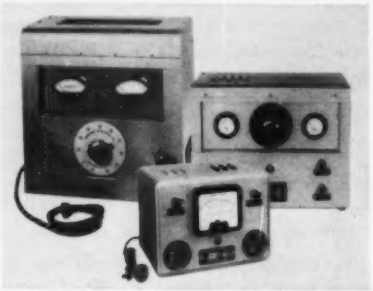
It is recommended for use at 2-4 oz./gal. at 140 to 200°F. in all types of metal washing machines including pressure spray machines, spiral-type washers, paddle wheel washers, and agitated basket-type machines. It is designed to remove oils, drawing compounds, solid dirt, and shop soil.

The rust inhibiting properties of the product provide protection to cleaned steel parts during temporary storage. The degree of rust protection can be increased by adding ½ oz./gal. to the final rinse stage of the washing machine.

Electroplating Power Units

Warner Electric Co., Inc., Dept. MF, 1512 W. Jarvis Ave., Chicago 26, Ill.

Three new electroplating power units, to cover a full range of plating operations from quantity production to customized experiments, are rated



at 5, 10 and 50 amperes capacity. The units require no special wiring or installation, operate from a standard 110-120 volt, 50-60 cycle, single phase AC current. Complete operating instructions are included.

Power units feature continuous range auto transformer to permit infinite control of current and voltage, plus automatic protection against overload and short circuits. Full wave rectification assures high efficiency at all times. Tested capacity ratings are conservative to provide an additional safety factor and ample power reserve. Each unit is totally enclosed in a heavy gauge steel cabinet with a lustrous silver hammertone finish, resistant to fumes and acids.

Zinc Bath Brightener

Conversion Chem. Corp., Dept. MF, Rockville, Conn.

A new, concentrated, permanent type brightener for cyanide zinc plating solutions, called Kenvert No. 15-BR, is a liquid, freely soluble in water, and in the zinc plating solution. It exhibits excellent stability to break down in zinc solutions operated at higher than normal working temperatures, it is claimed.

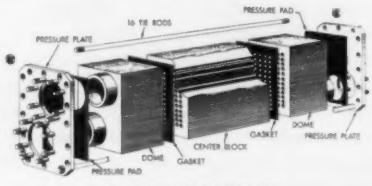
A further advantage is the fact that additions do not have to be made on a frequent basis. Additions on a shift or daily basis are adequate. The product gives a full, bright range from high to low current density areas, making the product satisfactory for use in either rack or barrel plating baths.

The brightener is offered for sale in 5 gallon pails with easy pouring spout. Complete compatibility with all of the above firm's chromating and bright dipping solutions is guaranteed.

Graphite Heat Exchanger

National Carbon Co., Dept. MF, 270 Park Ave., New York 17, N. Y.

Fluid flow on both sides of this new exchanger, designated Type CFB, contacts impervious graphite only. The heat exchanger is only 13 by 21 inches in cross-section, and provides more heat transfer area per square foot of space than any other type of exchanger, it is claimed. It is stocked in 1, 3, and 5-pass models with equal areas and number of passes in each



TYPE CFB HEAT EXCHANGER

Cut-away of a typical single-center-block Type CFB heat exchanger.

side, and can also be supplied with unequal numbers of passes on each

New burnishing compound

SAFEGUARDS steel media!

. . . yet produces a brilliance, a deeper lustre on brass, copper, nickel silver and silver surfaces. It's ideal for stainless steel and steel parts, too. You'll find that non-saponaceous, dust-free TV-4 leaves no dulling film and it eliminates the need for cleaning. Parts are all ready for lacquer or plating, and in less time, too. Burnishing time is cut and except in cases of severe tarnish, acid pickling prior to burnishing can be eliminated. Special ingredients in TV-4 permit lower concentrations and still remove oxide film while burnishing. Even if you leave the work in solution overnight, TV-4 will not tarnish it nor will it pit or rust your steel media.

You'll agree that TV-4 was planned with *your* problems in mind. Let us send you our Bulletin on this new compound . . . then let us show you what TV-4 can do right in your plant.

PLANNED SERVICE *for better metal finishing*

THE Hubbard Hall CHEMICAL COMPANY • Waterbury, Conn.

LOOK FOR THE DIAMONDS—SIGN OF FINISHING QUALITY

4 good reasons why you should use IRIDITE®

Chromate Conversion Coatings

FOR FINISHING ZINC OR CADMIUM

CORROSION PROTECTION

The wide range of Iridite coatings available gives you a choice of corrosion protection—from economical, mild protection of parts for shipment, storage or display, to extremely high protection under exposure to marine and highly humid atmospheres, gasoline or other hydrocarbons.

PAINT BASE

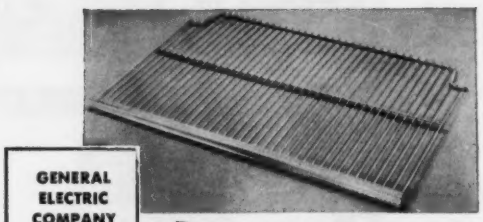
For an extremely tight bond for either baked or air-dried paints, non-porous Iridite blocks moisture penetration—prevents formation of metallic soap products beneath paint coatings.

APPEARANCE

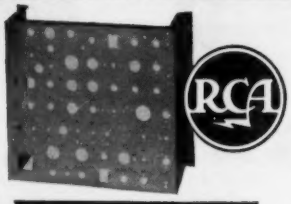
Your choice of colors ranging from clear through yellow iridescent to olive drab. Bright Iridite finishes can also be dyed to provide other color effects.

SPECIAL EFFECTS

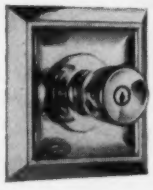
Iridite, in combination with other Allied Research processes, can provide a wide variety of finishes. As an example, Iridite 8-P applied to zinc or cadmium, followed by an application of Irilac, gives a highly attractive simulated brass finish.



GENERAL ELECTRIC COMPANY



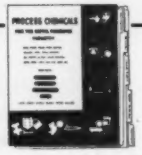
RCA



Medalist
NATIONAL LOCK COMPANY

WEIRTON STEEL COMPANY

IRIDITE—a specialized line of chromate conversion coatings for nonferrous metals. Easily applied at room temperatures with short immersion times, manually or with automatic equipment. Forms a thin film which becomes an integral part of the metal. Cannot chip, flake or peel. Special equipment, exhaust systems or highly trained personnel not required.



For complete information on Iridite, contact your Allied Field Engineer. He's listed in the yellow pages under "Plating Supplies." Or, write for FREE TECHNICAL DATA FILES.

Allied Research Products, Inc.

4004-06 EAST MONUMENT STREET • BALTIMORE 5, MARYLAND
BRANCH PLANT: 400 MIDLAND AVENUE • DETROIT 3, MICHIGAN

West Coast Licensee for Process Chemicals: L. H. Butcher Co. • European Agent: Sture Granberger, Storgatan 10, Stockholm, Sweden

Chemical and Electrochemical Processes, Anodes, Rectifiers, Equipment and Supplies for Metal Finishing

IRIDITE® Chromates | IRILAC® Coatings | ISOBRITE® Brighteners | ARP® Supplies | WAGNER Equipment

side for such applications as steam heating and condensing. The number of 24-inch long center blocks can be varied from one to six to provide a range of heat transfer area (for three-pass unit) from 35.2 to 176.7 sq. ft. The addition of center blocks makes it simple to increase capacity as required. The exchanger can be operated at hydrostatic pressures up to 100 p.s.i.g., and at temperatures up to 338°F.

Barrel Finishing Compound

Minnesota Mining and Mfg. Co., Dept. MF, 900 Bush Ave., St. Paul 6, Minn.

Honite One-Twenty-Six, a new burnishing compound, is claimed to hold better color in barrel finishing zinc die castings. The free flowing soap type compound also maintains color on steel and most alloys.

Frequently, a relatively small amount of the new compound can be used in the cutdown cycle; then, without rinsing the load, more compound can be added for the burnishing cycle. That saves one step in barrel finishing and lowers compound costs. The compound also is effective in smaller quantities than most burnishing compounds, it is stated.

Split-Eyelet Pipe Connectors

Spraying Systems Co., Dept. MF, 3245 Randolph St., Bellwood, Ill.

In installations requiring fittings for 1¼", 1½" and 2" piping or equivalent size tubing, these new No. 8370 split-eyelet connectors frequently can offer considerable savings in overall cost. Because they are easily and quickly installed to continuing or uncut pipe or tube lengths, installation time and fitting costs are significantly reduced.

The connectors are used in place of reducer Tees, and to connect such parts as spray nozzles, gauges, and hose nozzles. The split-clamp is made of cadmium plated, heavy-gauge steel or of stainless steel. The bodies provide a ½" NPT female outlet and are made in choice of brass and stainless steel. The connectors are mounted simply by drilling a $\frac{1}{8}$" diameter hole in the pipe or tubing and placing the connector in position. Twin-bolt compression of the clamp in combination with a special Buna-N gasket provides a leak-proof seal. Connectors may be used for liquids and gases up to pressures of 150 p.s.i.

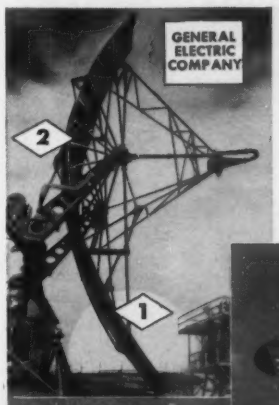
LOOK FOR THE DIAMONDS—SIGN OF FINISHING QUALITY

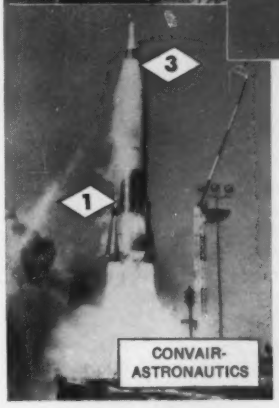
for protection on light metals

you need IRIDITE

PROCESS ENGINEERED CHROMATE CONVERSION COATINGS

1. Iridite protects against high altitude weather extremes and against corrosion by hydrocarbon fuels, such as gasoline and kerosene.
2. Iridite provides a highly protective non-porous paint base.
3. Iridite protects against corrosive storage conditions.





And, Iridite gives you these additional advantages:

ON ALUMINUM—needs only normal precleaning. Film withstands cold forming or bending. Easily heliarc welded. Unusually low electrical resistance. Clear, yellow or dye-colored finishes.

ON MAGNESIUM—short immersion, room temperature solution, no electrical equipment. Corrosion protection relatively unaffected by high drying temperatures. Applicable to all alloys. Low electrical resistance. Color ranges from light gray to dark brown.

IRIDITE—a specialized line of chromate conversion coatings for non-ferrous metals. Easily applied at room temperatures with short immersion, manually or with automatic equipment. Forms a thin film which becomes an integral part of the metal. Cannot chip, flake or peel; special equipment, exhaust systems or highly trained personnel not required.

For complete information on Iridite, contact your Allied Field Engineer. He's listed under "Plating Supplies" in the yellow pages. Or, write for FREE TECHNICAL DATA FILES.

Iridite is approved under government and industrial specifications.

Allied Research Products, Inc.

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Chemical and Electrochemical Processes, Anodes, Rectifiers, Equipment and Supplies for Metal Finishing

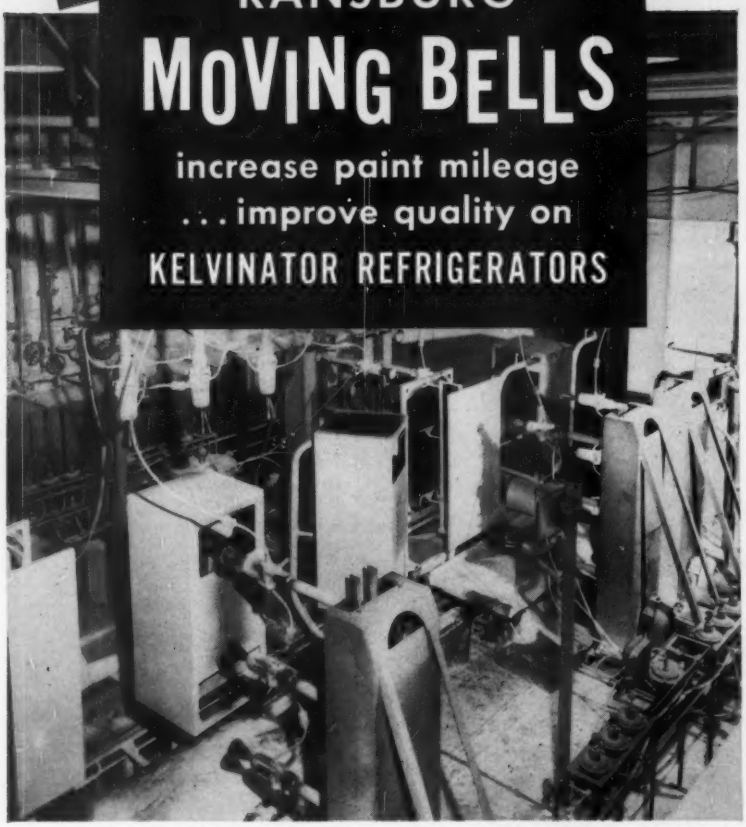
IRIDITE® Chromates | IRILAC® Coatings | ISOBRITE® Brighteners | ARP® Supplies | WAGNER Equipment

NEW

RANSBURG

MOVING BELLS

increase paint mileage
. . . improve quality on
KELVINATOR REFRIGERATORS



Ransburg's No. 2 Process moving bells—latest innovation in electrostatic painting—automatically paint mixed sizes of refrigerator cabinets and doors on Kelvinator's new finishing line.

On this job—first of its kind—limit switches re-position the reciprocating bells to accommodate various model sizes mixed on the same line. And, electric eyes selectively trigger the paint on and off between parts.

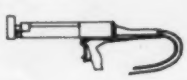
RESULTS? Automatic electrostatic spray painting—which replaced a battery of reciprocating automatic air guns—is providing Kelvinator with a beautiful, higher quality, and more uniform finish. Rejects, formerly a troublesome problem, have been practically eliminated. And, along with appreciable labor savings in this highly automated set-up, paint mileage is substantially improved . . . even bettering the savings indicated in pre-installation lab tests at Ransburg.

Like Kelvinator, other manufacturers of quality products will find Ransburg's moving bells the automation answer for production lines where batching of similar parts is impractical.

NO REASON WHY YOU CAN'T DO IT, TOO!

Want to know how Ransburg No. 2 Process can improve the quality of YOUR painted products—and at the same time—cut YOUR paint and labor costs? Write for our No. 2 Process brochure. Or, if your production doesn't justify automatic painting, let us tell you about the No. 2 Process Electrostatic Hand Gun which can be used in either conveyorized, or non-conveyorized painting.

RANSBURG



RANSBURG Electro-Coating Corp.

Box 23122, Indianapolis 23, Indiana

Phosphating Cleaner

Bell-Ray Chem. Corp., Dept. MF, 121 N. Broadway, Milwaukee 2, Wis.

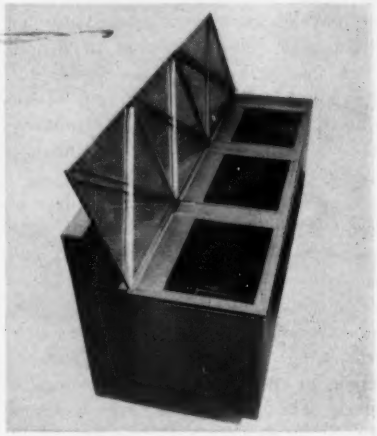
The improved version of Chem-Bond is distinguished by very good rinsability. It also imparts to coatings a superior impact-resistance. A further advantage is that ferrous metals, zinc-base die castings, galvanized iron, aluminum, copper, and brass can all be cleaned and phosphated using the same solution. This greatly reduces space requirements and costs in plants where a variety of metal products have to be processed. There is no need for bulky and costly equipment; the process is extremely simple.

The material is applied by immersion, brush-on wipe off, and spray, and is claimed to improve adhesion of organic finishes and electrodeposits.

Cascade Rinse System

Bendix Corp., Pioneer-Central Div., Dept. MF, Davenport, Iowa.

The cascade rinse unit has three rinse stations. The rinse solution is pumped into the first station, overflowing into the second and subsequently into the third station where it is drained for subsequent rejuvination and recirculated. Parts being rinsed are submerged in chamber three followed by submersion in two, and subsequently in chamber one, the cleanest of the three stations. After rinsing, parts are normally dried in a forced air dryer.



The rinse cabinet shell is constructed of #18 gauge mild steel with grey hammerloid finish. The tanks and top are #14 gauge type 302 stainless steel. Cascade rinses are available with three 14 x 20 inch or three 18 x 25 inch chambers.

Miniature Filter Chambers

Sethco Mfg. Corp., Dept. MF, 2284 Babylon Turnpike, Merrick, N. Y.

Miniature filter chambers for filtering small volumes of corrosive chemicals as well as solvents are now avail-

Model L-1 "Full View" Filter Chamber

able in Lucite, epoxy, PVC, and Teflon. The filter chambers are only 5" high and 2" in diameter, weigh approximately 8 oz. and have a filtering capacity of 5 to 7.5 gal./hr. Filtration can be viewed through the clear Lucite or Pyrex shell of the chamber. Filter tubes are available in cotton, Dynel, porous stone and carbon, depending upon application, for filtering from 150 down to 1 micron. For convenience in mounting, all filter chambers are furnished with a threaded stainless steel type 316 center rod which extends through the base of the chamber. Connection can be made to the chamber using 3/8" ID tubing which is pressed over the stainless steel type 316 inlet and outlet hose adapters. A stainless steel air vent is provided on the top plate for bleeding air out of the chamber during filtration as well as for draining the last drop of liquid before disassembly.

Sand Blast Machine

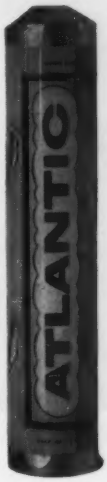
Pressure Blast Mfg. Co., Dept. MF, 27 Pleasant St., Manchester, Conn.

A small, compact sand blast machine for the automatic stencilling and marking of metal, glass and plastic components, is designated as Model 173 and is a re-designed version of the Model 162 which has been marketed for a number of years.

In operation, the operator places the

ATLANTIC
GREASELESS COMPOUNDS
with Exclusive K-134 additive give
Highest Quality Finish!

Atlantic greaseless buffing compounds with K-134 work faster, more economically, and most important, produce a *higher quality finish* on metal, plastics, and wood. Atlantic compounds are uniform . . . you'll get the same good results tube after tube. Atlantic manufactures *only* greaseless compounds. Rigid quality controls and constant research enable Atlantic to offer the finest finish compounds for all applications. Technical data, assistance and samples furnished on request. Call your Atlantic distributor today.



K-134, Atlantic's exclusive miracle additive, enables these compounds to:

- Reduce Application Time
- Adhere better to buffing wheels
- Cut down costly waste
- Assure uniform satin finish

ATLANTIC COMPOUND CO.

6 Charles St., Chelsea 50, Mass.

MANUFACTURERS OF GREASELESS COMPOUNDS ONLY

parts to be etched in a work locating fixture on the top of the cabinet. Visual observation and location of the workpiece is not necessary. The sand blast nozzle is located within the cabinet and fixed in a vertical position. The flow of abrasive is controlled by a foot pedal. In other versions of the Model 173, two, three and four nozzles can be fixed into position. The number of nozzles is determined by the masking job to be done. Stencil work up to ¼" round or ⅞" square can be handled by a single nozzle. If larger areas are to be marked, the number of nozzles needed is increased.

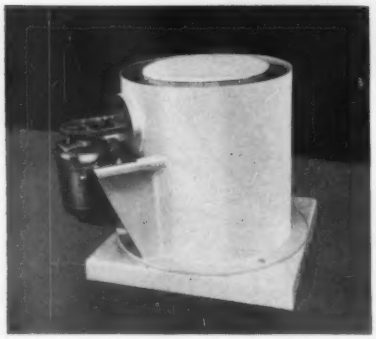
The cabinet is fabricated of heavy gauge welded steel and measures 37" wide by 19" deep by 31" high. Provision is made for ducting to the rear of the cabinet.

Plastic Roof Ventilators

Heil Process Equip. Corp., Dept. MF, 12850 Elmwood Ave., Cleveland 11, Ohio.

Fabricated of Rigidon plastic, these new, solid plastic roof ventilators combine utmost corrosion resistance and efficient fan design, assuring long, corrosion-free service exhausting corrosive fumes. All parts of the ventilator in contact with the fumes, including the impellor, housing, weatherhood, inlet and other parts, are of solid plastic.

The impellor or fan, of very efficient design, has up-blast discharge that blows the fumes high into the air, minimizing corrosion to nearby roofs, parking lots, and other ground areas. The impellor is driven with either a direct drive, or V-belt drive with easily adjustable screw take-up for the belt. In both designs the motor is protected from exposure to the fumes and is readily available for lubrication and periodic inspection. The ventilators have low silhouette to make a pleasing appearance on the roof, are extremely quiet in operation, and are non-resonating.



They are available in 10 standard sizes ranging from 6" to 30", with either plain inlet, collar inlet, or flanged inlet to meet the requirements of connecting ducts.

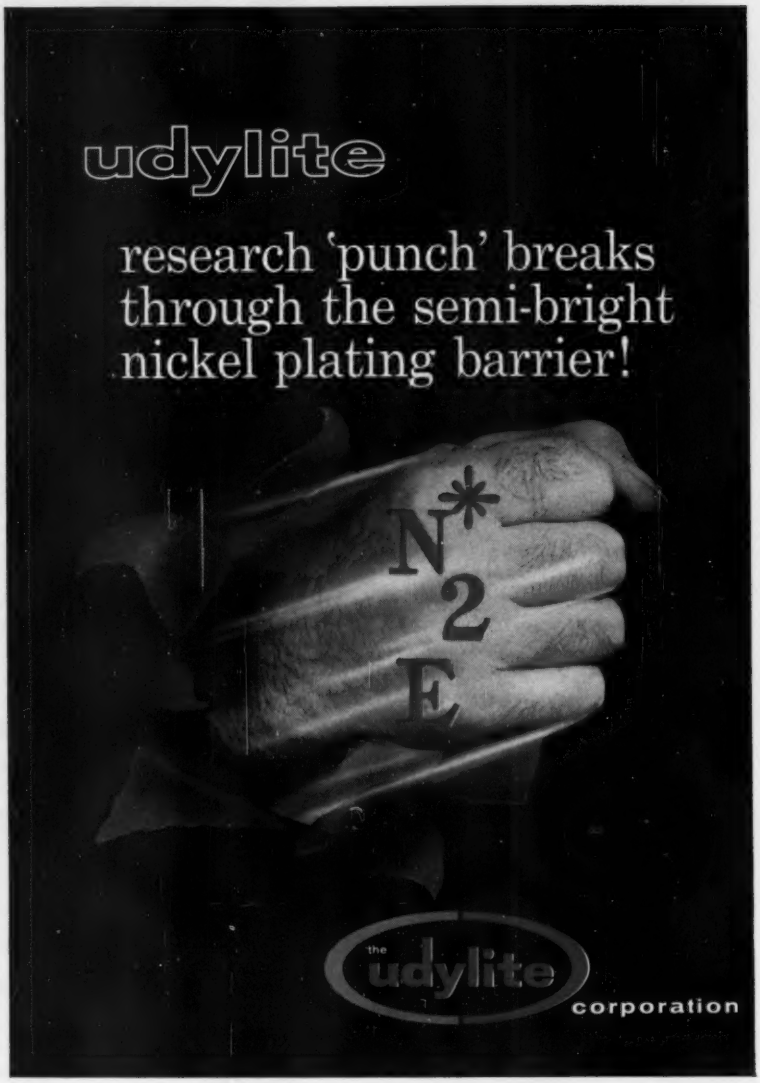
Temperature Regulators

Leslie Co., Dept. MF, 172 Delafield Ave., Lyndhurst, N. J.

Eventemp regulators are single seated, self-contained units, diaphragm actuated, with a unique level-type internal pilot. There are only two moving parts in the regulator body, no close fitting parts to clog, bind or seize. Two common temperature regulator trouble spots that often lead to faulty regulation and overheating problems are eliminated in units which have a pressurized, self cleaning, friction-free Teflon stem seal and a tight closing, positive seating main valve. Trim parts can be readily inspected or renewed without removing the body from the pipe line.

Temperature variations are sensed by a liquid filled thermo-element which is fully interchangeable when the regulator is on the line, eliminating any messy vapor filling maintenance requirements or factory repairs. A large variety of thermo-elements, spans and bulb materials are available.

The regulators are available with



✳ BRAND NEW PROCESS is easier to operate and control, provides better uniformity of color and greater production efficiency than ever before!

here's why:

NO HARMFUL BREAKDOWN PRODUCTS. There are no harmful materials formed from the N2E addition agents as a result of the plating process! Thus, batch treatment is necessary only when contaminants from other sources enter the bath and continuous carbon filtration will not remove them. The result is a substantial saving in solution, downtime, manhours and additional chemicals ordinarily required to treat and rebuild the plating bath.

CONSISTENT UNIFORMITY. N2E addition agents are noncritical in concentration. Reasonable variations from recommended concentrations will not seriously affect the characteristics of the deposit. Overall uniformity of color is maintained. Even in deep recesses on the backs of intricate die castings, amazingly clean deposits are obtained.

WIDE CURRENT DENSITY RANGE. N2E's average current density range is 30 to 60 amperes per square foot, with a considerably higher limiting current density. This wide range permits faster plating at a higher average current density without burning.

GREATER TOLERANCE TO METALLIC IMPURITIES. The absence of harmful breakdown products is of special importance in connection with metallic contaminants, since the undesirable effects of the two are cumulative. Another N2E 'plus' factor that helps maintain uniformity and quality.

ADHESION GREATLY IMPROVED. Production experience over a considerable period of time has conclusively demonstrated the excellent adhesion characteristics of Udylite N2E in combination with the Incomparable '66' Bright Nickel Process.

ECONOMICAL CONTINUOUS FILTRATION. One of the outstanding advantages of N2E is the fact that the bath can be continuously filtered through an activated carbon pack without appreciable loss of brighteners. The cleaning action of the continuous carbon filtration permits long periods of uniform, high quality production. The stability of N2E addition agents also permits economical bath purification by low current density electrolysis.

CAN BE ADDED DIRECTLY TO BATH. N2E addition agents are liquid and can be added directly to the bath without the use of filters. For high-speed operation, air agitation of the bath is recommended, although N2E performs well with mechanical agitation and can even be used without agitation.

See for yourself what N2E can do to improve your plating operation. Submit one of your problem parts for test plating now. See your Udylite representative. Or, write or phone:

world's largest plating supplier

udylite

detroit 11, michigan • on the west coast: L. H. Butcher Co.

cast iron or bronze bodies, with screwed or flanged ends in a complete range of sizes from ½" to 4", inlet pressures up to 175 p.s.i., temperatures to 500°F. Optional features include external impulse connections for low inlet pressures, continuous bleed for cooling service and calibrated dials for quick setting without waiting for equipment to heat up.

Vinyl Dispersion Resin

Union Carbide Plastics Co., Dept. MF, 270 Park Ave., New York 17, N. Y.

Yielding high structures at low rates of shear and rapid gelation rates, a new stir-in type dispersion resin, Bakelite vinyl resin QXKV-2, is now available for high quality coating and molding applications.

The new resin is designed for plastisol and high-solids, low-solvent organosol dip coatings, and gives exceptional performance in rotational and slush molding applications and in machine-applied coatings. Good viscosity stability is maintained in dip tanks and during slush molding recycling. Plastisols based on the resin can be readily vacuum deaerated, will release air rapidly, and are less affected by humidity during the process than plastisols based on other resins of this type, it is claimed. Heat stability is also superior.

Lead-Tin Anodes

Alpha Metals, Inc., Dept. MF, 56 Water St., Jersey City 4, N. J.

Tin-lead solder anodes of virgin metal so pure "sludge" deposits are virtually eliminated, claim impurities limited to as little as .02% of bismuth and antimony. Other impurities are in proportionately low amounts. Designed for plating electronic components and printed circuits, the anodes are available in extruded form.

The anodes are available in 3 shapes: round, elliptical and flat. Round anodes are extruded in 1½"-2" diameters. Flat anodes come in a range of dimensions. Each shape is for use with any of a wide variety of reusable hooks or cast copper hooks solder-coated and bonded to the anode stock.

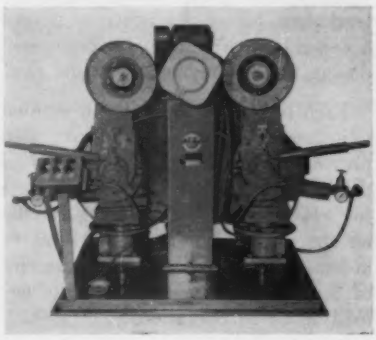
Double Head Buffing Machine

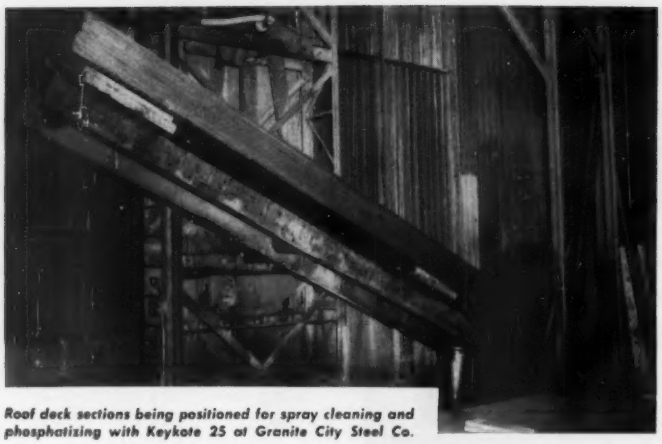
Acme Mfg. Co., Dept. MF, 1400 E. Nine Mile Road, Detroit 20, Mich.

A new self-contained, double-head, automatic polishing and buffing machine for finishing round or oval shaped parts or parts of rectangular shape having rounded corners, provides a combination cut and color buffing operation for high luster finishing. Depending on part size, shape and finish desired, production rates of from 60 to 150 finished parts per hour can be achieved. Air line pressure directed to cylinders controlling the wheel contact pressure is automatically varied when contact surfaces change from flat to radius configurations.

The machine consists of two special G-4 adjustable buffing lathes, with floating spring loaded pivoted wheels, mounted on a common base with a revolving spindle workholder.

Each lathe is equipped with a timer controlled air cylinder arrangement which automatically pivots the buffing heads "in" for finishing operations and "out" to facilitate loading and





Roof deck sections being positioned for spray cleaning and phosphatizing with Keykote 25 at Granite City Steel Co.

Granite City Steel Co. relies on Kelite KEYKOTE® 25

for superior corrosion protection in the manufacture of their ribbed steel roof decking of noted high quality. Finishing is accomplished in one of the world's largest conveyor systems for paint preparation and painting.

Keykote 25 is a powdered composition which produces dense complex phosphate coatings from water solutions. While not an iron phosphate, it competes in that class. It embodies iron for ductility, zinc for galvanic protection, manganese for hardness and ferromolybdate for passivity. The result is superior performance at low cost.

Keykote 25 baths produce little or no sludge or scale. Solutions are easy to control and a single material is used for make-up and replenishment of the bath.

Application is by one to six stage spray washer, immersion, or steam phosphatizing methods.

For further information write the nearest Kelite Office listed below. Ask for Keykote 25 bulletin F21.

U. S. PATENT NOS. 2,557,509, 2,826,517, 2,885,312. OTHERS IN PROCESS. ALSO PATENTED IN CANADA, AUSTRALIA, AND GREAT BRITAIN.

KELITE CORPORATION

• Los Angeles 12 • Chicago 45 • Berkeley Heights, N. J

unloading operations at the end of an automatic finishing cycle. The timer control is pre-set for a desired finishing cycle to provide uniform finish quality at maximum production rates. Each lathe is separately timed so that one wheel will be retracted from the workpiece before the other to permit a coloring operation to be preformed during the last revolution of the part.

Each lathe is equipped with manual adjustments to raise and lower and provide "in" and "out" positioning of the buffing wheels and to compensate for wheel wear. The revolving spindle on the machine is also controlled to automatically stop rotating at the end of the finishing cycle to facilitate unload and load operations.

Water Demineralizer

Barnstead Still and Sterilizer Co., Dept. MF, 223 Lanesville Terrace, Boston 31, Mass.

A new replacement cartridge demineralizer with capacity of 25 gallons per hour, the BD-5 consists of a pressure-type cartridge holder equipped with a direct reading purity meter calibrated in parts per million impurities and ohms electrical resistance. The meter indicates water purity at all times and also shows when to replace cartridge.

The unit can be operated under pressure up to 100 p.s.i. The cartridge holder is constructed of steel, lined with polyvinyl chloride, while the demineralizer head is faced with tin. It occupies space of only 6" x 8" x 26".

A standard cartridge with capacity of 1,500 grains removal as NaCl with endpoint of 50,000 ohms or higher can be used in the unit. For operations demanding higher purity, one million ohms electrical resistance and a neutral pH, the mixed-bed cartridge is recommended by the manufacturer.

Portable Infra-red Heater

Bryant Industrial Products Corp., Dept. MF, 17700 Miles Ave., Cleveland 28, Ohio.

A new portable gas-fired infra-red burner for research and testing of low-temperature industrial infra-red process applications has a self-contained 2 hour supply of propane gas from a replaceable tank. The completely portable burner has a built-in carrying handle which doubles as a foot support for bench use. It operates at any angle.

Face temperature of the 4 x 6 inch radiant screen can be varied from 1,200 to 1,800°F. Radiant heat emission is in the 2.0 to 4.0 micron band—the optimum wavelength range for maximum heat absorption by most materials. Nominal heat output is 10,000 Btu per hour. The radiant screen is Inconel for peak heat release and longest service life. The one-piece screen removes for easy maintenance. Burner dimensions are 4 in. x 9 in. x 15 in. overall; the unit weighs 12 pounds.

High Solids Vinyl Coating

Amercoat Corp., Dept. MF, 4809 Firestone Blvd., South Gate, Calif.

A new high build vinyl coating, No. 99 has been developed for application with either conventional or airless

spray equipment. The new coating is not a mastic, yet it overcomes the application disadvantages of most vinyls, which require multiple coats to achieve minimum protective thickness. As a result, substantial savings are being obtained on material and labor required to provide lasting protection against industrial, chemical, petroleum and marine corrosion.

When applied with airless spray equipment, only one cross-sprayed coat is required to obtain a dry film thickness of more than 5 mils. Using conventional spray equipment, only two coats are required to produce a dry film thickness of 5 mils. Handling characteristics are excellent; the coating barely sags even with a wet film thickness of 25 mils.

It may be applied over organic primers; when teamed with one coat of an inorganic zinc silicate coating, it is unequalled by any other known coating system for purposes which it is intended.

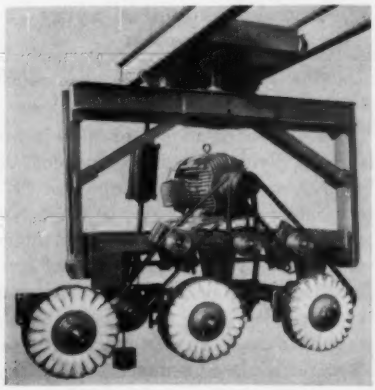
The coating dries to a hard and tough matte finish which adheres firmly and resists abrasion. Non-flammable, odorless and non-toxic, it will not harbor bacteria or fungi.

Buffing Machine

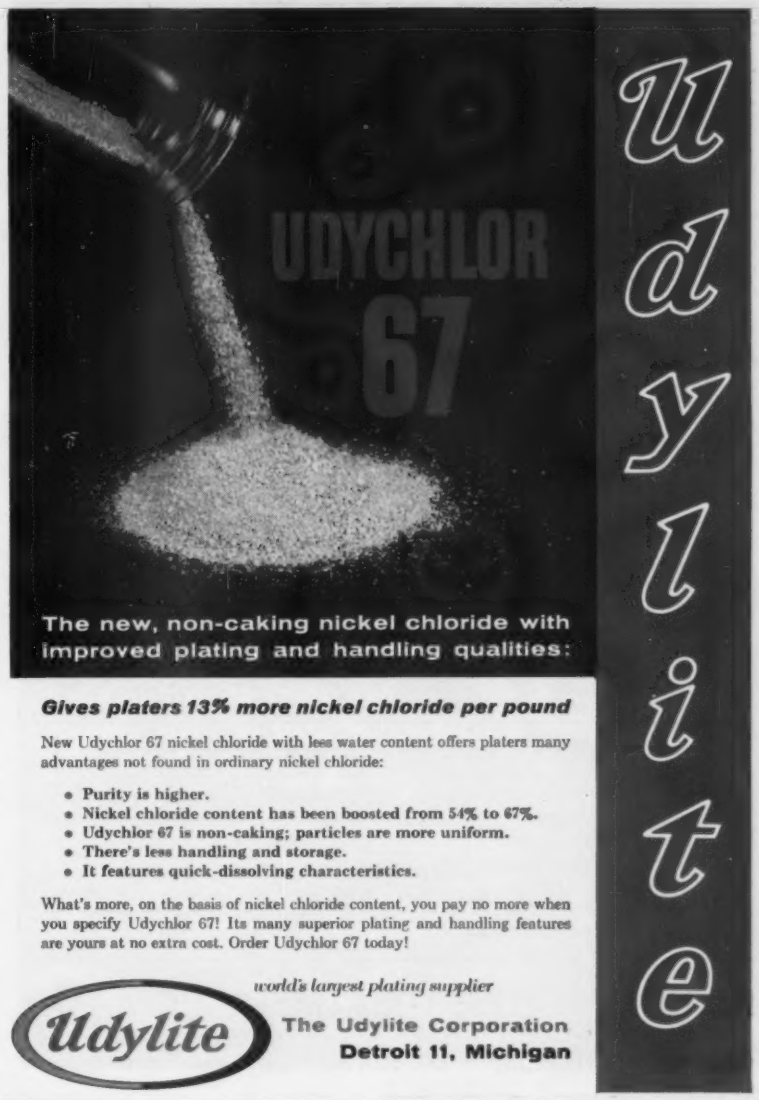
Murray-Way Corp., Dept. MF, P. O. Box 180, Birmingham, Mich.

A versatile, compact work head, employing three buffing wheels driven by a single motor, and suspended from a mobile, overhead wheel carriage, is specially designed to buff and polish part curvatures not ordinarily reachable by floor mounted heads. This new work head leaves the floor area completely clear and clean; allows easy access to conveyor and head for positioning, tilting, and other adjustments.

Each wheel floats independently of the others, and vertical positioning of the complete head is handled by a screw and nut arrangement on the hanging column. The unit may be ordered with either individual or unison wheel wear adjustment, controlled either manually or by automatic push button. Uniform work pressures are maintained either by individual air cylinders or by the compact and completely automatic torsion balancing unit.



The work head may be equipped with an air-operated power cylinder which will lift all three wheels from the work simultaneously, and provision is made for take-up of the V-belts on each head.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67
The new, non-caking nickel chloride with improved plating and handling qualities:
Gives platers 13% more nickel chloride per pound
New Udychlor 67 nickel chloride with less water content offers platers many advantages not found in ordinary nickel chloride:
• Purity is higher.
• Nickel chloride content has been boosted from 54% to 67%.
• Udychlor 67 is non-caking; particles are more uniform.
• There's less handling and storage.
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What's more, on the basis of nickel chloride content, you pay no more when you specify Udychlor 67! Its many superior plating and handling features are yours at no extra cost. Order Udychlor 67 today!
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Flame Proof Buff Treatment

American Buff Co., Dept. MF, 2414 S. La Salle St., Chicago 16, Ill.

"Yellow Flameproof Treatment" is now available on all cloth bias buffs manufactured by the above company. The new treatment, characterized by a slight yellow coloring, imparts positive flame protection to all buffs so treated. Buffs cannot ignite even when directly exposed to fire.

The new treatment is ideal for cloth bias buffs used in high-speed lathe operations, where buffs constantly build up heat due to long periods of contact with work. The treatment is economical, only slightly higher in cost than an untreated buff. Savings in operation

Don't throw it away! **RECOVER YOUR ALUMINUM BRIGHT DIP SOLUTION**

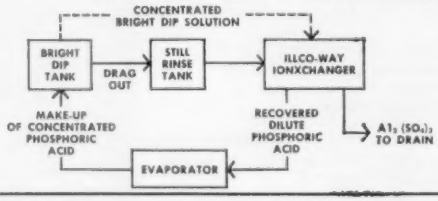
ILLCO-WAY

ionXchange

SPECIALIZED EXPERIENCE SHOWS HOW TO SAVE MONEY

The use of ion-exchange eliminates the need for dumping expensive phosphoric acid. Four years of successful experience in recovery of bright dip solutions enables us to make several recommendations, depending on particular conditions. Usually, we employ a cation exchanger to purify the first rinse, recovering phosphoric acid which has been carried over from the bath by dragout. Another treatment removes aluminum direct from the bath. The use of IWT ionXchange can not only improve the uniformity of your product through better quality control in the plating, but also can be a very *profitable* investment.

PROCESS CAN BE USED IN SEVERAL WAYS



The block diagram at the left illustrates the general methods of treatment suggested above. Actually, every installation presents its own special problems — which IWT engineers are well-equipped to solve. *So, consult your IWT representative for specific suggestions.*

ILLINOIS WATER TREATMENT COMPANY

840 CEDAR STREET
ROCKFORD, ILLINOIS

NEW YORK OFFICE: 141 E. 44th St., New York 17, N.Y.
CANADIAN DIST.: Pumps & Softeners, Ltd., London, Ont.

are also achieved, as the treatment extends buff life and provides better compound retention, according to users' reports.

Portable Vibratory Finisher

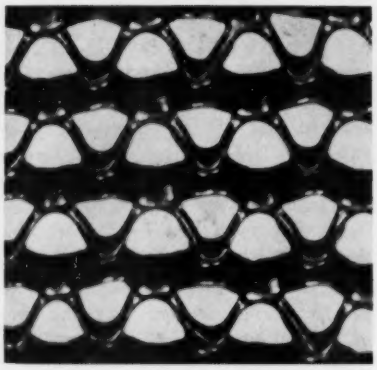
Stevenson Co., Dept. MF, Wellsville, Ohio.

The portable Vibrodyne Model V-013 is 18″ long, 11″ wide, 11.5″ high and weighs 29 lbs. The ⅛ cu. ft. (approximately one gallon) tub capacity may be rotated to any angular position for dumping or screening. The companion control (not illustrated) is 6″ wide, 6½″ deep, 10½″ high, weighs 8 lbs. and is complete with electric timer, pilot light, fuse, and variable transformer. Operation is from 115 volt, single phase 60 cycle power, consuming less than 40 watts.

Amplitude of vibration is varied by the variable transformer, while the frequency is maintained at 3,600 pulsations per minute. 100% scrubbing action between media and parts takes place in both the horizontal and vertical planes as all the material is vibrated in the tub. This scrubbing action provides for precision finishing of parts many times faster than by conventional methods.

Protective Rubber Mesh Matting

Research Products Corp., Dept. MF, Madison, Wis.



An addition to its line of Neotex rubber mesh matting has been announced by the above manufacturer. The new design has a symmetrical pattern, and the manufacturer claims that, because it is softer, more pliable, its function is expanded. It is produced in rolls 26″ x 50′ and can be very easily cut to any desired size or shape — to provide an attractive, colorful, safe and soft cushion.

Rubber Gloves

Surety Rubber Co., Dept. MF, Carrollton, Ohio.

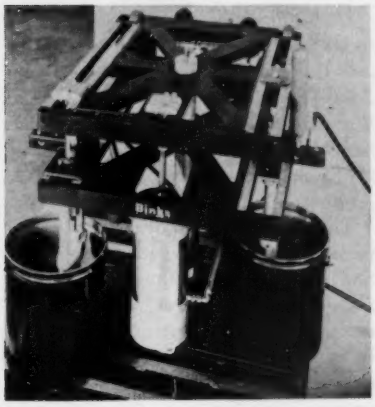
A new process that imparts a soft, velvety, easy on — easy off finish to lightweight natural rubber industrial gloves, Velvex is a permanent "built in" surface treatment that will not wash, wear, or rub off, and is guaranteed to remain effective for the life of the gloves.

Plural Component Spray Equipment

Binks Mfg. Co., Dept. MF, 3140 Carroll Ave., Chicago 12, Ill.

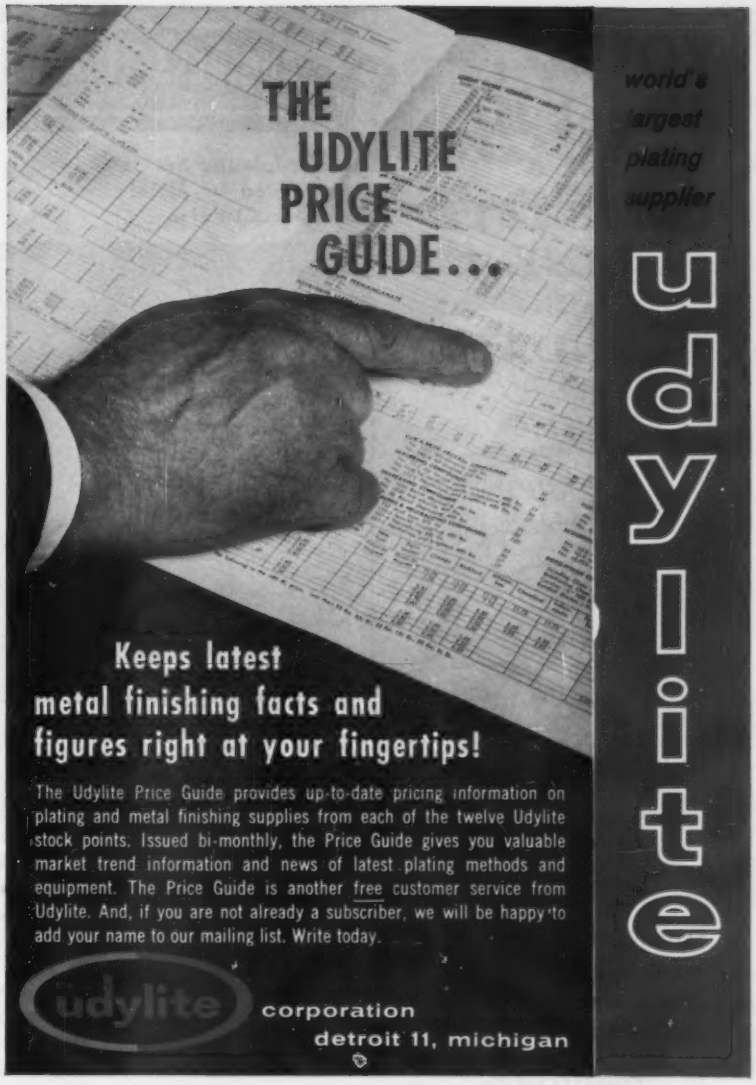
An improved model of a unit for spray-applying plural component or catalyst materials, the Formulator "B" accurately meters resin and catalyst materials to a spray gun for instantaneous spray or pour application of fast-reacting materials. The Turbulator gun can be used with unit for materials that have extremely fast reaction times. It mixes the two components internally

in the gun with a high speed mixing device, and sprays them immediately. Materials with reaction times as short as four seconds have been successfully sprayed, on a continuous basis. A catalyst gun can be used with slower reacting materials, or the standard Model 18 spray painting gun can be used as an injection gun.



The new device is all air operated, and will dispense materials from original shipping containers. Foams, Fiberglas reinforced plastics, epoxies, gel-coats, adhesives, and other reactive materials can all be handled. The system includes an air operated piston that drives two material pumps at a controlled delivery rate for accurate proportioning. Output of the two pumps can be finely controlled over a wide adjustment range.

Resins up to 50,000 c.p.s. are easily handled without heating. Operating capacity is from 0-10 pounds per minute, and proportioning accurracy is $\pm 0.5\%$ per pump.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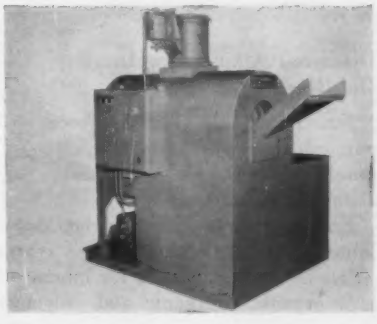
Cleaning Machine for Small Parts

Cincinnati Cleaning & Finishing Machinery Co., Dept. MF, 2026 Hageman St., Cincinnati 41, Ohio.

Just 5 feet long and 4½ feet wide, a drum-type cleaning machine designed specifically for low-cost volume cleaning of small parts has a variable speed drive which provides capacity ranging from 6 to 9 cubic feet of parts per hour.

In operation, parts are loaded into the machine manually from shop containers or direct from a conveyor discharging into the loading hopper. The parts are conveyed through the machine by a worm inside the drum, passing through a soak section, a spray section and finally a drain section before being automatically discharged. Time in the various sections is controlled by the variable speed drive.

The machine is completely self-contained, incorporating cleaning solution pump and motor, variable speed drive and motor, ventilating blower and motor, solution temperature controls and solution tank with access door to solution-filtering screens. The solution tank may be heated by steam, gas or electricity. Motor controls are mounted in a single enclosure with interlocked disconnect switch.



The tumbling action of the parts as they are conveyed through the machine assures efficient cleaning in both soak and spray sections and thorough draining as well. Similar machines can be provided for larger parts and may also incorporate cleaning or rinse sections and drying sections too.

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BUSINESS ITEMS

Electroplating Specialist Appointed by Metal & Thermit Corp.

William A. Hopkins

The appointment of *William A. Hopkins* as electroplating product specialist for *Metal & Thermit Corp.* was announced recently. He will be headquartered in the Detroit offices, and has been assigned special responsibilities for the firm's product line of anodes and chemicals for nickel-chromium plating.

Mr. Hopkins previously was general manager of the Sharonville Division plant of Electric Auto-Lite Co. near Cincinnati. From 1952 through 1957, he was vice-president in charge of sales for Bart Mfg. Co., Belleville, N. J. Prior to this, he was Michigan district sales manager for McGean Chem. Co. In all, Mr. Hopkins has been associated directly and indirectly with the electroplating industry for more than 25 years. A native Ohioan, he studied metallurgical engineering at the University of Cincinnati. He is a member of the A.E.S.

Diamond Alkali Appoints Dr. Black

Dr. Donald M. Black has been appointed to the position of manager of development and market research of *Diamond Alkali Co.*

Employed previously by the Monsanto Chemical Co. for thirteen years where he was responsible for innumerable organic, inorganic and polymer market research and market development projects, Dr. Black is also a widely known contributor to national technical publications. A graduate of Rensselaer Polytechnic Institute, Black received his PhD from the Massachusetts Institute of Technology in 1947.

Chemical Corp. Concludes Mutual License Pact

Under mutual licensing agreements recently concluded between the *Chemical Corp.* of Springfield, Mass. and *Tool Treatments (Chemicals) Ltd.* of West Bromwich, England, each company is now manufacturing and marketing the other's metal finishing trade products for home consumption.

The Luster-On line of chromate conversion coatings for corrosion protection and decorative finish of non-ferrous surfaces will thus be represented throughout Great Britain and Ireland. In exchange Chemical Corp. will offer the Blakodizing chemical blackening process for steel for the first time in the United States.

Basic arrangements for the licenses were concluded between *Bryant H. Gardner,* executive vice-president of Chemical Corp. and *Dennis A. G. Colling,* managing director of Tool Treatments, during Mr. Gardner's recent trip to England and the continent.

Detroit Division of R. O. Hull & Co. Moves to Larger Quarters

R. O. Hull & Co., Inc. announces that its Detroit Div. has moved into new, larger quarters at 66 East Ten Mile Road, Hazel Park, Mich. The new facilities, the third expansion in Detroit in the last two years, doubles their previous facilities.

Expanded laboratory analytical services, and local salt spray testing, will now be available to customers, and a complete line of Singelton barrels and

spare parts will also be carried at the new location.

Handy & Harman Appoints Townsend

M. W. Townsend, vice-president of administration of *Handy & Harman*, has been elected to the newly-created position of executive vice-president of

M. W. Townsend

the precious metals firm. In addition to his present responsibilities for the accounting and treasurer's departments, he will assume responsibility for the sales department.

Mr. Townsend joined the sales department of the company in 1946, later becoming sales manager, and then assistant to the president. He has been a director since 1955, and vice-president of administration since 1958.

Bacon Felt Expands Manufacturing Facilities

Bacon Felt Co. has acquired an additional 17,000 square feet of manufacturing area at 15 Fourth St., Taunton, Mass. in a building adjacent to the present plant. The new area will house the expanded blending department and will make possible a more efficient arrangement of the entire manufacturing operation. Additional blending and carding machinery has been purchased and will be installed soon.

Acquisition of the new space marks the third expansion for the company since 1951 when it moved to Taunton from Winchester. In 1956 the original plant was expanded from 50,000 to 60,000 square feet, and last year the executive, sales and engineering offices were moved from Water St. into modern quarters at 11 Fifth St.

STOP COSTLY CORROSION DAMAGE...

CEILCOTE E-900
. . . dependable coating for severe corrosion service!
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. . . acid-proof cement used with Ceilcote Brick!
CEILCRETE
. . . combined with glass cloth for extreme chemical resistance!
COROCRETE
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ENGINEERED FLOORS

Ceilcote *Engineered Floors* are the answer to costly floor maintenance problems caused by acid and alkali attack. And Ceilcote floors are engineered to withstand impact, thermal shock, abrasion and expansion without cracking or spalling! The installation shown above exemplifies Ceilcote's comprehensive approach to individual flooring problems . . . demonstrates how Ceilcote materials are carefully integrated to completely protect all types of surfaces. Working under contract, competent Ceilcote engineers analyze your operating conditions . . . formulate materials . . . direct surface preparation and installation by Ceilcote construction crews. Some installations can be installed under Ceilcote supervision or by plant personnel. *This complete flooring package with guaranteed performance is available only from Ceilcote!*

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For general commercial work, Handy & Harman anodes are 999+ fine. And it makes no difference in what shape or size they're made: ball, rod, plate, strip or sheet, they all have the same uniformly high degree of purity. What's more, if you want still finer anodes, you can specify the AA grade for high-speed plating, or finer, if desired. Handy & Harman supplies them all.

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Handy & Harman Refining Service has reached a state of perfection that assures you —in lot after lot—of *accurate* returns. Your anode ends, plating solutions, precious metal scrap, sweeps and waste are more *rewardingly handled* by Handy & Harman.

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John Carroll

sentative in Ohio, Indiana and Kentucky. This territory was formerly covered by Carroll's brother, Leonard, who has been associated with the company for the past eight years, and will now concentrate his efforts in the South with particular emphasis on Tennessee, North Carolina, Georgia, Arkansas and Texas.

Diversey Names Assistant Manager

The *Diversey Corp.* has named *W. C. Thompson* assistant manager of the Metal Industries Department. Since joining the firm in 1953, Mr. Thompson has been a metal industries field representative in the Los Angeles area. He assumed his new duties at the Chicago headquarters early in February.

Pittsburgh Plate Advances Widing in Chemical Div.

Appointment of *Robert E. Widing* to the newly-created position of manager of manufacturing for *Pittsburgh Plate Glass Co.'s* Chemical Division (formerly Columbia-Southern Chem. Corp.) has been announced.

Mr. Widing will headquarter in the company's Pittsburgh general office, transferring from the Chemical Division's Barberton, Ohio, plant where he had served as assistant works manager since 1956. He joined the Barberton plant in 1942 as a chemical engineer and in 1949 was assigned to Pittsburgh as technical assistant to the general superintendent of Columbia-Southern. Mr. Widing was named chief process engineer in 1952, and transferred to Jersey City, N. J., as works manager in 1954.

A native of Youngstown, Ohio, Mr.

J. Holland & Sons Elects New Slate of Officers

A new slate of company officers has been announced by *J. Holland & Sons, Inc.*, 475 Keap St., Brooklyn, N. Y. *Louis Holland*, who was named president, has been active in the family concern his entire career, joining the company in 1921. In addition to administrative duties, he is now responsible for the company's complex inventory control program, operation of its manufacturing divisions and subsidiary operations.

William Holland, elected treasurer, has also been with the company since the beginning of his career, starting in 1918. He is in charge of all financial administration as well as general management including sales and service.

Arthur Holland was elected secretary. A recent graduate of Brooklyn Polytechnic Institute, he joined the firm in 1950. His current duties are now involved in engineering, production and service operations.

Elected vice-president was *Abraham Polmar* who joined the organization in 1933. Mr. Polmar's responsibilities include purchasing, office management and sales.

Buckeye Appoints Carroll

The Speedie Buffing Composition Division of *Buckeye Products Co.*, Cincinnati, announces the appointment of *John "Buck" Carroll* as its sales repre-

Widing is a graduate of the University of Minnesota and a member of the American Institute of Chemical Engineers.

General American Transportation Corp. Acquires Infilco

General American Transportation Corp. of Chicago has acquired the outstanding stock of *Infilco, Inc.* Present plans are that the Tucson firm, for sixty-three years a leader in the field of water and waste equipment design and manufacture, will continue to operate under its present management as part of the Fuller group of General American.

Polymer Expands Operations in Chicago Area

The *Polymer Corp.*, producer of industrial plastics, has opened a new service facility in Industrial Park, Rolling Meadows, Ill. The new building will house the offices and warehouse of The Polymer Corp. of Penna., a subsidiary, which has been engineering and distributing nylon, Teflon and other plastic stock shapes in the Mid-West since 1947. A portion of the plant will be occupied by the Whirlclad Division to provide custom coating service for cladding metal parts with plastics by the Whirlclad coating system, a fluidized bed process.

Daniel Gray Joins Alpha Metals

Daniel Gray has been appointed special consultant on technical problems by *Alpha Metals, Inc.*, Jersey City, N. J. Previously, he was a leading research chemist with Oneida, Ltd. for 42 years. In addition to being responsible for all packaging materials (specially important in the silver industry), Mr. Gray worked on semi-micro and trace analysis development of improved methods of analysis. He particularly worked on instrumental methods.

Daniel Gray

Through his research experience, Mr. Gray has become a specialist in the problems of tarnish and corrosion. His work involved much study of silver and silver alloys, metallurgy of silver alloys, diffusion of metals and electrodeposition of metals and alloys. A graduate of Millikin University, Mr. Gray holds some 20 patents in the fields of electrodeposition, alloys, abrasives and packaging materials. His papers on indium plating, trace impurities in silver and electropolishing have been published by The Electrochemical Society and A.E.S.

Rhodes Transfers Schwemer to West Coast

Glen A. Schwemer, representative for *James H. Rhodes & Co.* in Wisconsin and Minnesota territories, has been transferred and is now representing the firm in the states of California, Washington and Oregon. He will work out of the west coast office at 2540 Huntington Dr., San Marino, Calif.

Mr. Schwemer founded the Electro Platers Co., Milwaukee, Wisc., and served as its president for seventeen years before becoming associated with Rhodes.

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DEBURR with...

ONE machine–ONE operator–ONE pass

Let's face facts—costs are high and will go higher. You can, however, *REDUCE* flat finishing costs with a Hammond Flat Finisher. Grinding, deburring, and finishing of flat surfaces of plates, printed circuits, bars, stampings, extrusions, etc., can be done uniformly on a high production basis with *ONE* machine ... *ONE* operator ... *ONE* pass.

Hammond Flat Finishers have the latest features: *automatic* belt tracking and oscillation, *automatic* air tensioning for abrasive belts and conveyor belt, *variable* speed conveyor, *ammeter* on each head, and other features which contribute to maximum production at lowest possible cost.

1 TO 6 HEADS
6" TO 12" WIDE

Available in 6", 8", and 12" widths

Send us one finished and a few rough samples so our engineers can analyze your finishing requirements. No obligation.

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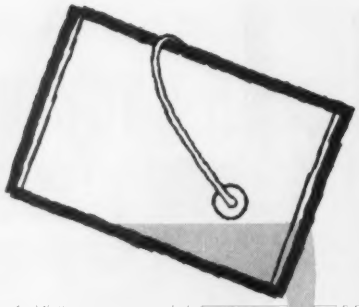

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NEW 8-PAGE HANDBOOK

Our new 8-page Nacreous Pigment Handbook and 4-page "Coating with Nacreous Pigments" brochure contain much valuable information on the use of Nacromer. Write for your copies today.

THE MEARL CORPORATION
41 EAST 42nd STREET, NEW YORK 17, N.Y.

Cowles Acquires Promat Division

Cowles Chemical Co., Cleveland, Ohio, officially consolidated the operations of its Metal Finishing Products Department with the recently acquired Promat Division at a week-long meeting in Waukegan, Ill. Personnel and territory assignments were announced. The following organization outline was also announced:

William J. Stark, sales manager: Sales representatives and headquarters: *Milton Pascal*, New York; *George Woleben*, Buffalo; *Elmer Lord*, Cleveland; *Clay Sayers*, Cincinnati; *James Goas*, Indianapolis; *William Swift*, Detroit; *George Egger*, Chicago; *Alexander Alexander*, Rockford; *Ernest Banner*, Minneapolis; and *George Olbur*, Los Angeles. Technical Service: *Russell Miller* and *Marvin Siddall*.

Production facilities of the Promat Waukegan plant will be moved to Cowles' new plant in Joliet, Ill., early this Spring. Service laboratory and pilot plant equipment will also go to Joliet. A second service laboratory for eastern customers will be established at the Skaneateles Falls laboratories.

Ross Engineering Moves Seattle Office

The Seattle office of *J. O. Ross Engineering* recently moved into larger quarters. Formerly at 823 Skinner Bldg., the office is now located at 2909 Third Ave., Seattle 1, Washington.

Paul Goldner is the Seattle district sales manager.

Glidden Appoints McGuire

Appointment of *John K. McGuire* as manager, transportation sales and national accounts for The *Glidden Co.'s* Paint Division was announced recently. In his new capacity Mr. McGuire will be responsible for both trade and industrial national accounts and will coordinate his activities with the firm's regional directors and sales managers. He will integrate all sales effort on national accounts through the headquarters offices of those accounts.

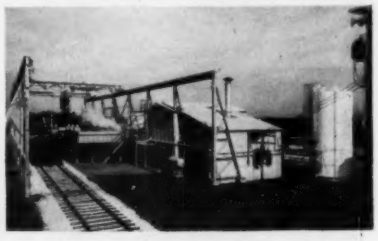
A graduate of the University of Notre Dame and the Graduate School of the University of Michigan, Mr. McGuire joined the company in 1950 in the trade sales department of the Central Region. He later became associated with the industrial department of that region and in 1953 became an industrial sales representative, handling both industrial and transportation accounts.

Mr. McGuire will be located at the division headquarters in Cleveland, Ohio.

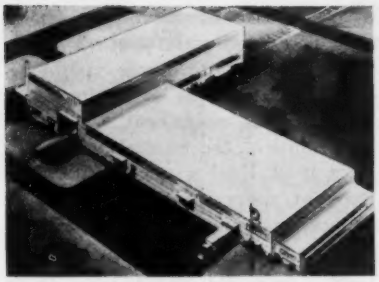
Two Detinning Plants for Metal & Thermit

Metal & Thermit Corp. announces the opening of one detinning plant and construction of another, in Tampa, Florida and Hamilton, Ontario, Canada, respectively.

The Tampa half-million dollar, eleven-acre plant, begun last August, has been opened east of the city in



Tampa Plant



Hamilton Plant

the Summit Corp. Industrial Park, on Route 301, just north of Route 60.

The plant will use a modern chemical process to recover tin from tin plate scrap. Because the United States is almost entirely dependent upon imports of tin to fill its needs, reclamation of this basic metal through detinning operations serves as important function for industry.

Ground has now been broken for construction of the plant in Canada, which is to be built and operated by the firm's Canadian subsidiary, *M & T Products of Canada, Ltd.*

The plant will use the modern alkaline detinning process to remove tin from high quality scrap produced in can-making operations. Tin chemical by-products will make the company the first Canadian source of supply for sodium and potassium stannate, used for electroplating with tin and for immersion coating of aluminum pistons for internal combustion engines.

Onnen Joins Cuno Engineering Corp.

Appointment of *Donald S. Onnen* as a member of the sales engineering division has been announced by The *Cuno Engineering Corp.* He joins the firm after five years as chief equipment engineer and operational director of research for the New York, New Haven, and Hartford Railroad. Earlier he was associated with the General Electric Co. in various technical, engineering, and sales capacities for fourteen years, including foreign service in South Africa and Europe.

Onnen is a graduate of the University of Maryland with a degree in Mechanical Engineering and has taught technical and sales programs at General Electric.

Delavan Names Three Representatives

Delavan Mfg. Co., West Des Moines, Iowa, has announced the appointment of three new manufacturers representatives. *O'Brien Steam Specialty Co., Inc.* of Syracuse, N. Y., will cover upstate New York. *Hovey Spray Equip. Co.*, 63rd and Vine Sts., Philadelphia, Pa., will serve representatives in eastern Pennsylvania, southern New Jersey, Delaware, Maryland and Washington, D. C. The third representative is *King & Shepherd, Inc.*, 50 Church St., New York City. They will serve metropolitan New York and northern New Jersey.

Banquet During Recent Sel-Rex Sales Seminar

Sel-Rex sales and marketing personnel from all over the country photographed at banquet held during their recent three-day Sales Seminar at famed Motel On The Mountain, Suffern, N. Y. The meeting featured lecture and discussion periods headed up by various technical, sales and marketing executives of Sel-Rex Corp., and subsidiary, The Meaker Co.

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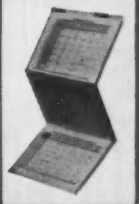

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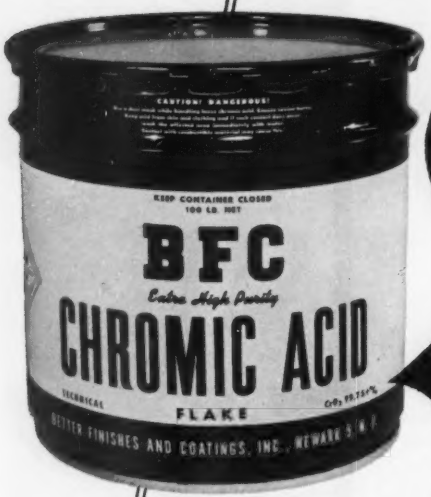

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Dr. Prater Appointed by General Electric

The appointment of *Dr. Thomas A. Prater* as manager of the Process Laboratories Unit has been announced by the *General Electric Co.* Research Laboratory. The unit provides large-scale metal processing services to aid in the transition of new materials and processes from the laboratory to full-scale commercial production. It also produces highly specialized metal articles for the laboratory and other company components.

Dr. Prater is returning to the research laboratory from the general engineering laboratory, where he helped set up a program to study the application of magnetohydrodynamics, a new system of generating electric power, to large-scale power stations. He will continue to devote part of his time to this study as a consultant.

Dr. Thomas A. Prater

Before this assignment, Dr. Prater had been with the research laboratory since 1952. He has specialized in the study of alloys for high temperature applications, and has published many papers and reports on such metals.

Dr. Prater first joined the firm in 1951, as an engineer in the Metallurgical Products Department in Schenectady. Previously he had taught at Pennsylvania State University. He received his Ph.D degree from Penn State in 1950.

Azzolino New Technical Director at E. C. Electroplating

Joseph Azzolino

Joseph Azzolino has recently been appointed technical director for *E. C. Electroplating, Inc.*, Garfield, N. J. Prior to joining the firm, Mr. Azzolino was technical advisor on electrodeposition and surface treatments for the engineering, manufacturing and customer service department of the Wright Aeronautical Division of Curtiss Wright Corp.

He also served as technical sales & service representative for Heatbath Corp., Springfield, Mass.

Diversey Names Willey District Manager

Diversey Corp. has named *E. B. Willey* metal industries district manager for the Pacific Coast area.

In his new position Mr. Willey, a metal industries representative for the firm since 1953, succeeds the late *C. F. Wentworth*. He will make his headquarters at the South Gate, Calif., office.

Cooper Alloy Names Vice-President

Cooper Alloy Corp., Hillside, N. J., has announced the appointment of *Gerald Lewis* to the position of vice-president, marketing and engineering.

Mr. Lewis was formerly director of products engineering for the corporation, a post he held since 1959. He joined the Vanton Pump and Equip. Corp. Div. in 1955 as sales manager. Prior to this Mr. Lewis was chief engineer of the J. J. Ashton Co. of New York, and was employed as industrial engineer with the Conmar Zipper Co. of Newark, N. J.

During World War II, Mr. Lewis was a weather officer in the U. S. Air

Gerald Lewis

Force. A 1948 graduate of Columbia University, he holds a Bachelors degree in Industrial Engineering. He was, for several years, an instructor in industrial management courses at Hofstra College and Columbia University.

Licensees Named by Pfaudler

Five additional firms have been licensed to apply Pfaudlon 301, a sprayable coating of Penton in water-suspension, according to an announcement made by *The Pfaudler Co.* The licensees are *Inner-Tank Lining Corp.*, Cincinnati, Ohio; *Livingstone Coating Corp.*, Charlotte, N. C.; *Tank Lining Corp.*, Oakdale, Pa.; *Hanszen Plastics Co.*, Dallas, Tex.; and *Industrial Coatings Corp.*

Hurley Named General Manager of Acoustica Div.

Appointment of *Ronald J. Hurley* as general manager of the Acoustica Division of *Acoustica Associates, Inc.*, Los Angeles, was announced recently.

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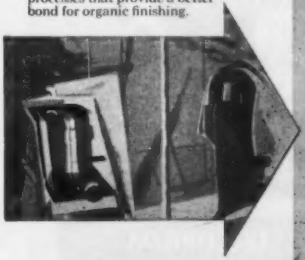
HERE'S HOW PAINTITE SCORES ON SURVEY'S 12 "MOST WANTED" FEATURES...

—Formulated as Result of Industry-Wide Survey...

During the first six months of 1959, Turco undertook an extensive survey of the phosphate coating market. Hundreds of users of these coatings were interviewed. Thousands of questions were asked. When the answers were tabulated, Turco began the task of building an iron phosphate process to the *exact specifications* called out in the survey.

The new process is now available. It is called Turco Paintite. Paintite has been thoroughly field-tested in the production lines of a dozen Turco customers. It has passed the most severe tests with flying colors. Turco is proud to announce the addition of Paintite to its ten other Turcoat phosphate and conversion coating processes that provide a better bond for organic finishing.



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10. **RESERVE ACIDITY**–combats alkaline water conditions. Constant control not necessary.
11. **SUPERIOR SERVICE**–by Turco's vast network of technically trained servicemen, located in industrial centers throughout the world.
12. **REQUIRES ONLY 3 STAGES**–for dip or spray washing. Can be efficiently used in 5-stage operations, if desired.

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NAME
TITLE
MF

Ronald J. Hurley

Hurley, former manager of contract administration for the aircraft division of Hughes Tool Co., joined the company in July, 1960, in the capacity of director of services. He was graduated from the University of South Dakota and holds a bachelor of law degree.

Seaporcel Metals, Inc. Names Assistant to President

J. P. Wilhelm has been appointed assistant to the president of *Seaporcel Metals, Inc.* At one time, he headed up his own company in the porcelain enameling field — Southwestern Porcelain Steel Corp., Sand Springs, Okla. He was formerly associated with Moore Enameling and Mfg. Co., West Lafayette, Ohio, as executive vice-

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president and treasurer; and headed sales of the sign division of Atlas Enameling Co., Inc., St. Louis.

Sprayon Announces New Warehouse Facilities

Newly expanded warehouse facilities at the company's No. 4 plant on East 70th St. have been announced by *Sprayon Products, Inc.*, Cleveland, Ohio. Equipped with the latest in materials-handling equipment, the new facilities will accommodate some 600,000 aerosol cans ready for shipment.

Bell Heads New Economics Laboratory Division

William J. "Red" Bell, has been named national sales manager, Transportation Cleaning Products Div., *Economics Laboratory, Inc.*, Guardian Bldg., Saint Paul, Minn.

Bell has a background of 17 years in the transportation industry. He was a sales representative for the Motor Cargo division of Consolidated Freightways, and spent 13 years with Northwest Airlines' freight, passenger and international divisions. He will direct administration and expansion of his division's sales program on a national level.

William J. Bell

New Firm in the Cleaning Machine Field

AutoSonics, Inc., of 4217 Chestnut St., Philadelphia, Pa., is a recently organized firm, formed to design, manufacture and distribute the new AutoSonex automated cleaning machine that utilizes ultrasonics. The company will also produce conventional industrial cleaning equipment and paint finishing systems.

Metalclean Equipment Co., developer of the AutoSonex degreaser, is now a division of the new firm, of which *Burton Rand* is president.

Pittsburgh Plate Creates New Unit in Detroit Paint Division

Pittsburgh Plate Glass Co.'s Paint Division has announced that a newly-created product uniformity department has been established in its Ditzler Color Division at Detroit, Mich. The expanded facility will satisfy increased demands for products of better and more uniform quality by closely controlling each step of the manufacturing process, thereby assuring strict conformance to customer specifications. The production service group within the new unit will provide liaison between technical and production departments and be responsible for the smooth integration of the new department into the manufacturing operations.

Harold W. Redshaw, formerly technical director at Ditzler, has been ap-

pointed manager of product uniformity. He joined the Division as a technician in 1935. He is a graduate of the Detroit Institute of Technology and a member of the Detroit Paint and Varnish Production Club.

Cook Joins Winter Mfg. Co.

A. Everett Cook, formerly chief production chemist of *Tektronix, Inc.*, has resigned in order to accept the position as plating supervisor and chief chemist for *Winter Mfg. Co.* in Portland, Ore. He will be responsible for all production and research in the Electroplating Division.

Mr. Cook, recently elected president of the Portland Branch of the A.E.S., was chairman of the highly successful educational program now in its third year of formal schooling currently at Portland State College, and is the corresponding consultant for the establishment of plating schools within the Argentina, South America, electroplating fields.

NEWS FROM CALIFORNIA

Efforts of a group of Los Angeles area plating shop owners to prevail upon the State of California to sponsor an apprentice platers training course have been successfully concluded, and the program was initiated early in February.

The project was started last fall by a number of shop owners in the San Fernando Valley district of Los Angeles, who decided that a plating training course was needed to replace the discontinued night school classes in metal deposition formerly offered by UCLA and Woodbury College.

A group headed by *Ted Goodman* of Michael Rand Plating Co. and *C. E. DeLucca* of Space Age Plating Co., both in Van Nuys, Calif., held a number of meetings last fall and conferred with representatives of the California State Board of Education and State Employment Department. On January 11 DeLucca advised METAL FINISHING that arrangements had been concluded under which a Platers' Apprenticeship Training Course will be offered under state sponsorship at the Van Nuys Adult High School.

The course will be supervised by an industry council composed of plating shop owners but conducted by the state as part of its apprenticeship training program for different industries. The class started in February in the form of a four-hour night school session one evening a week. The classroom lecture series will be supplemented later by on-the-job training in approved plating shops so that the full three-year course will give the student technical classroom instruction as well as practical work in the shop.

Classroom instruction will include the chemistry and mathematics of plating, safety, cost and management procedure, and the technical and scientific aspects of metal finishing, polishing, buffing, burnishing, plating tank technique, solution preparation, and the various forms of plating. Included will be information and instruction on the latest developments in precious metal plating which the growth of the missile and electronics industries in Southern California has brought to the fore in recent months.

A plating industry council has been named to pass on applicants for the training course. To be eligible a young man or woman must actually be working in a plating shop and will additionally be evaluated on interest in the

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- Color constant
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business, aptitude for it, and character.

The council consists of the following: *Ted Goodman* (chairman) Michael Rand Plating Co.; *C. E. DeLucca*, Space Age Plating Co.; *Donald Dixon*, Dixon Hard Chrome Co.; *Roland Moody*, Chemical Metals Co.; *Henry Saakland*, Vineland Plating Co.; *Edward Brookshire*, Dialectric Plating Co.; and *Donald Hudson*, Hudson Plating Co. All the firms mentioned are located in the San Fernando Valley area of Los Angeles. Five more shop owners will be named to bring the permanent plating industry council to twelve.

Named as class instructor is *Meyer Roter* whose background in the industry covers every phase, from shop employee to shop owner to supervisor of plating departments for various large manufacturing concerns. At present Roter is manager of the printed circuit fabricating and plating division for Radiophone, Inc., Van Nuys, Calif.

Goodman announced that well over the 20 students required to get the course underway had been signed up by January 2nd. Young men and women interested in the class may obtain further information by contacting *Ted Goodman*, Michael Rand Plating Co., 16018 Strathern St., Van Nuys, Calif., Phone ST 2-9280.

Officers of the Metal Finishers Association of Southern California are reported to be observing the progress of the San Fernando Valley training project closely, with the thought of possibly arranging for a similar class to be held in downtown Los Angeles.

Norman Painter, who succeeded to the post of plant foreman for the Hall-Mak Co., Los Angeles, following the retirement from that position of *Don Bedwell* several years ago, reports that Don is recuperating at his home in Inglewood, Calif., following a recent operation. Don, now 71, is the only living honorary life member of the A.E.S. of Los Angeles Branch.

William Griff has resigned as plating superintendent for Graffic Circuits, Inc., Los Angeles, and on January 10 joined U. S. Engineering, Inc., Van Nuys, as a consultant on printed circuit procedure. Mr. Griff transferred his activities to Southern California from Phoenix, Ariz., in March, 1960. In Phoenix he had been plating superintendent for Motorola, Inc. and, at the time of his departure, was serving as first president of the newly-created Phoenix Branch of the A.E.S.

Paul A. Waalkes has been named sales manager at *Alert Supply Co.*, Los Angeles and San Francisco. In his new capacity he will be responsible for all sales. Prior to his appointment, Waalkes was assistant general manager at J. C. Miller Div., Hanson-Van Winkle-Munning Co., Grand Rapids, Mich.

Mr. Waalkes holds a B.S. degree in Chemistry from the University of

Paul A. Waalkes

Michigan. He served as a pilot in the United States Army Corps during World War II and attained the rank of Captain after spending two years in the South Pacific.

Mr. Waalkes is an active member of the A.E.S. He has held all offices in the Grand Rapids Branch and is presently serving on the national level on the publication committee.

News items have also come to this column concerning two other beloved veterans of the Southern California plating industry:

Clarence Thornton, 80, retired as of December 31 after more than 30 years as vice president in charge of the Los Angeles branch of the L'Hommedieu Co. He has been succeeded as branch manager by *Larry O'Neil*, who has been with the firm since 1939.

Carroll McLaren, a L'Hommedieu representative, reports that he took time off during the holidays to drive to Temple City, Calif., for a visit with *John Merigold*. John, now 87, is living in retirement in Temple City with Mrs. Merigold. He had been active in the precious metal phase of the plating industry (Merigold Plating Co.) in Los Angeles and New Jersey for more than 60 years before his retirement in the early 1950's.

McLaren reported Merigold as being "—hale, hearty and chipper—" and bemoaning the fact that he was now out of the business just when the missile and electronics industries are giving precious metal plating its biggest boom in history.

A visitor to Southern California in January was *Alfred Weisberg*, vice-

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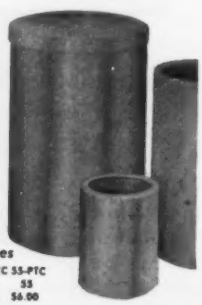

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president of Technic, Inc., Providence, R. I. Weisberg graciously answered an emergency call for help by the educational chairman of Los Angeles Branch of the A.E.S. when speaking arrangements for the January 11 meeting ran into a road block. Weisberg flew to Los Angeles from Chicago to address the branch on precious metal plating as applied to the electronics industry.

Behr-Manning Co. has announced the appointment of *Robert C. Jones* as manager of industrial sales for the Portland, Ore. division. Jones will handle the post in addition to his present one of division sales manager at Seattle, Wash.

Harold C. McClellan, president, Old Colony Paint & Chem. Co., Los Angeles, was elected 1961 president of the Los Angeles Chamber of Commerce at the January 12 meeting. The new officers and directors were installed at the annual banquet on February 1.

The Filtra Corp., a new firm which specializes in the production of mechanical filters for the aircraft, missiles and commercial industries, has been established in Burbank, Calif., with plant and offices at 120 West Providencia Ave. *Charles Schaefer* is president, *N. Stanley Leland* vice-president, and *Phillip Purer* secretary-treasurer.

The firm's cleaning system is a Swiss-designed vacuum unit that provides a vacuum in the ultrasonic stage to develop the full effectiveness of cleaning and filtering.

Metal Control Laboratories, Los Angeles, has been acquired by Magnaflux Corporation of Chicago, a subsidiary of General Mills Corp. The new owners have announced that the MC Laboratories will be operated as part of the Magnaflux organization to effect a complete complement of integrated non-destructive, metallurgical and physical testing facilities.

The 12th Western Metal Congress, scheduled for March 20 to 24th at the Ambassador Hotel, Los Angeles, will present a program of 32 half-day technical sessions, more than at any previous conference.

The American Society for Metals will present eight of the sessions. Other sessions will be sponsored by the American Society for Testing Materials, U. S. Air Force, Metals Society of A.I.M.E., Society for Nondestructive Testing, and Society for Aerospace Materials and Process Engineers.

Programs have been prepared on such subjects as metals research, metallurgy for advanced design, process metallurgy, value engineering, laboratory methods, heat treating methods and others concerned with formation, processing and finishing of metals.

The 12th Western Metal Exposition will be held in the Pan Pacific Auditorium on the same dates (March 20-24). Exhibit hours have been arranged so there will be no conflict with the technical sessions. Members of societies that are collaborating in presenting the congress and show receive free tickets by mail. Exhibitors are permitted to acquire admission invitations at the cost of 5 cents each to take clients and prospects to the show.

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Heavy Duty Detergent

Oakite Products, Inc., Dept. MF, 118 Rector St., New York 6, N. Y.

RR Cleaner, a strongly alkaline cleaner designed for "really rugged" cleaning jobs, is described in Service Bulletin No. 17B, recently published.

Finishing Processes

MacDermid Inc., Dept. MF, Waterbury 20, Conn.

Metex Nickel Activator M-668, an organic activator that can be used by immersion only or with cathodic current is fully described in Technical Data Sheet No. 118, which contains detailed operating conditions, recommended cycles and control procedure for the product.

Metex T-103, a highly efficient alkaline metal cleaner that provides excellent penetration into deep recesses, rapid wetting of oily surfaces, fast softening and displacing of grease deposits and complete and rapid emulsification of oily soils is fully described in Technical Data Sheet No. 40, which is a revision of previous sheets, and contains the latest recommended operating conditions, suggested cleaning cycles and control procedures.

Electro-Gleam 55, a liquid acid electropolish material that works equally well on carbon steel, aluminum and stainless steel is fully described in Technical Data Sheet No. 81. The data sheet contains detailed operating conditions, recommended equipment and cycle and control procedure for the product.

Solvent Degreasers

Phillips Mfg. Co., Inc., Dept. MF, 3475 W. Touhy Ave., Chicago 45, Ill.

A four-page, illustrated brochure describes liquid-liquid-vapor degreasers. Bulletin 22 explains the principles of operation of liquid-liquid-vapor degreasers; then discusses the solvent cycle and the construction of the unit. Included in the bulletin is a table of specifications to be used as a guide for specific degreasing operations.

Solution Filters

Sethco Mfg. Corp., Dept. MF, 2284 Babylon Turnpike, Merrick, N. Y.

One-page Bulletin 551A contains complete technical description and prices of the "submerged" leak-proof filter systems for precious metal plating solutions, corrosive liquids and sensitive solutions. Bulletin 401 describes corrosion resistant "Full-View" filter chambers.

Barrel Finishing

Barrel Finishing Equip. Div., Baird Machine Co., Dept. MF, 1700 Stratford Ave., Stratford, Conn.

A brief new folder summarizes the above firm's complete line of barrel finishing units and replacement barrels. Each of the 7 basic units in the line are illustrated and described in brief "thumbnail" paragraphs. Six basic types of replacement barrels are handled in the same manner.

A perforated postcard, as part of the folder, allows the reader to request more complete, detailed information on any of the equipment.

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Industry's Abrasive { ABRASIVE BONDING CEMENT for Wheels and Belts

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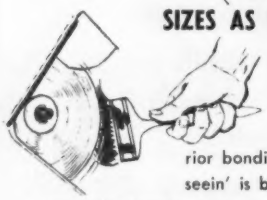

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New Construction for longer Service . . .

STUTZ CONSTRUCTION

Heavy gauge steel with wire woven through steel angle firmly attached to main stem. Cannot come apart or loosen. Side clip is for STUTZ BARREL PLATING TANKS having submerged rectangular anode bars. Side clip not furnished for racked plating tanks. Standard hook 6 inches. Other hook lengths available, however deliveries could be delayed.

WELDED CONSTRUCTION

Note how welds have dissolved or broken in use. Often caused in barrel plating where currents are high and barrel transfer is rapid.

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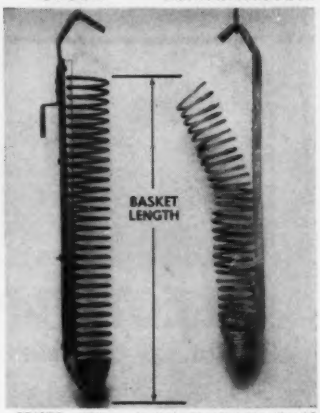

PRICES—12¢ per inch for basket lengths 18 inches or longer in increments of 3 inches. Side clips 15¢ extra. Shorter containers available at 18" price. Curved containers one size only, 27" for 14" and 16" diameter barrels 15¢ per basket additional.

The STUTZ Company
Complete Metal Finishing Equipment & Supplies
4430 Carroll Ave.
Chicago 24, Ill.

Automatic Polishers

Packer Machine Co., Dept. MF, 456 Center St., Meriden, Conn.

Eight basic types of automatic polishing and buffing machines are described in a new illustrated folder. The machines are of the rotary indexing, continuous rotary, horizontal conveyor and straight line conveyor type. Information on each of the units includes the number of heads available, work table or conveyor size, number of work holding spindles, production rate output and the type of work piece each machine is best suited to handle.

A handy postcard is affixed to the folder which allows anyone interested to obtain more particular information on any of the machines described, arrange for free test processing of samples, etc.

Vibratory Finishing

Vibraslide, Inc., Dept. MF, 95 Prospect Ave., Binghamton, N. Y.

An eight-page booklet entitled "Considerations in the Evaluation of Vibratory Finishers" tells of the introduction of vibratory action in barrel finishing, how it is achieved, and the practical advantages of the system, with specific examples given in each case.

Vacuum Metalizers

NRC Equip. Corp., Dept. MF, 160 Charlemont St., Newton 61, Mass.

A condensed 8-page catalog of high vacuum components and equipment summarizes a complete line.

Metal Primer

Wisconsin Protective Coating Corp., Dept. MF, Green Bay, Wis.

A new heavy duty epoxy type primer containing lead silico chromate, iron oxide and leafing type pigments, especially formulated to provide good bonding qualities and overall high chemical resistance is described in new technical bulletin M-24.

Blast Cleaning Barrels

Pangborn Corp., Dept. MF, Hagerstown, Md.

Exclusive features found in the above manufacturer's standard-duty line of blast cleaning barrels are described in Bulletin No. 706.

Automatic Chromium Determination

Technicon Controls, Inc., Dept. MF, Chauncey, N. Y.

Automatic determination of chromates is described in a new 2-page methodology sheet. The complete chemical methodology is detailed for the rapid determination of chromates down to parts per million using the AutoAnalyzer, an electronic analytical instrumentation system which requires no supervision. A flow diagram of the analytical system is included, together with the actual chart recordings derived.

Infra-red Comfort Heaters

Fostoria Corp., Dept. MF, 1200 N. Main St., Fostoria, Ohio.

A new line of electric infra-red comfort heaters for direct radiant heating of hard-to-heat indoor and outdoor areas without costly heating of the intervening air is described in new 8-page, 2-color Bulletin CH-100. Principles, advantages, and typical applications of electric infra-red comfort heating are discussed.

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USE **TRUE BRITE BRASS SOLUTIONS**

Trouble Free — Low Cost
Little Supervision Needed
Ready To Use — Just Add Water
Uniform Color — Can Match Colors

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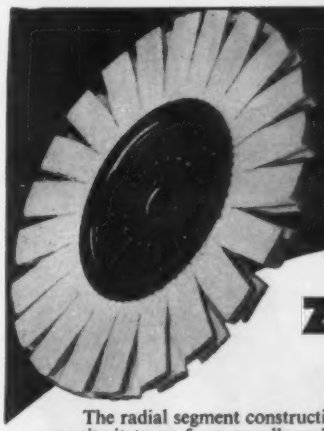

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FORMAX **ZIP-TIP BUFFS**

The radial segment construction of the Zip-Tip Buff permits it to perform equally well on flat or contoured surfaces. The cross-cutting movement of the spoke-shaped segments prevent work streaking while it breaks up straight-line patterns on the surface.

- Zip-Tips are available in a wide variety of all cloth constructions —also combinations of cloth and sisal.
- Zip-Tips are made of heavy-duty, bias-cut materials mounted on ventilated steel centers.
- Zip-Tips are extra thick and provide wider buff faces with greater compound retention capacity.
- Zip-Tips are perfectly balanced —require no raking.

Write for Descriptive Literature

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DETROIT 7, MICHIGAN
"THE FOUR McALEERS"

Vinyl Resins for Solution Coatings

Union Carbide Plastics Co., Dept. MF, 270 Park Ave., New York 17, N. Y.

A "how-to" booklet on vinyl solution coating formulation techniques provides the coatings formulator with valuable basic information on the general properties and uses, formulations and preparation of clear, as well as pigmented coatings, and application methods. Also, included are two particularly useful tables listing the pigments and dyes suitable for tinting vinyl finishes.

Lacquers for Vacuum Metalizing

Schwartz Chem. Co., Inc., Dept. MF, 50-01 Second St., Long Island City 1, N. Y.

A new data sheet, printed in Spanish, describes the use of lacquers and dip dyes in a three-step process that assures high quality metalized finish for polystyrene articles.

The Spanish data sheet is a translation from the English version for industries providing increasing employment of Spanish speaking people.

Immersion Tin Plating

Shipley Co., Inc., Dept. MF, Walnut St., Wellesley 81, Mass.

A data sheet is available on Cuposit LT-26, a process for depositing pure tin onto copper, copper-based alloys, and lead-tin electroplate by immersion. Information is given on its applications and properties, and instructions on how to make up the product, its uses and maintenance.

Solvent Degreasers

Phillips Mfg. Co., Inc., Dept. MF, 3475 W. Touhy Ave., Chicago 45, Ill.

A four-page, illustrated bulletin describes vapor-spray-vapor degreasers. Principle of operation, solvent cycle and a table of specifications on all models are discussed with clarity.

Heating methods, degreaser features and unit construction are also presented in the new bulletin.

Bonded Lubricant Coating

Alpha-Molykote Corp., Dept. MF, 65 Harvard Ave., Stamford, Conn.

The characteristics of Molykote PVE, a new bonded lubricant coating for ferrous surfaces, are described in a new data sheet. In addition to giving full specifications for the new coating, the two-page, two-color Bulletin 129 includes data from actual tests of the material.

Temperature Regulating Devices

American Instrument Co., Inc., Dept. MF, 8030 Georgia Ave., Silver Spring, Md.

Temperature regulating devices capable of routinely controlling air or liquid temperatures within a fraction of a degree are covered in a profusely illustrated catalog, No. 360. Bimetal and mercury thermoregulators, heaters, relays, stirrers, pumps, and transformers are included.

Wide Belt Polisher

The Carborundum Co., Curtis Machine Div., Dept. MF, P. O. Box 337, Niagara Falls, N. Y.

A brochure sets forth the specifications and advantages of the 150 series of abrasive belt machines which handle work pieces 1/20" to 3" thick to 49" wide, at infeeds up to 100 linear feet per minute.

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One-piece steel, heavily coated with plastisol... no spacer needed. Easy to install. Universal application. Standard sizes stocked. For details, call or write

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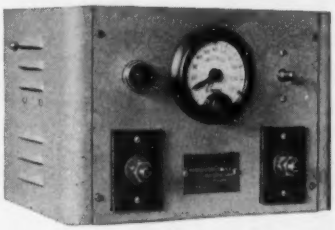
SAVE PRECIOUS METALS and PRECIOUS TIME with MACARR AUTO-TIMING CONTROL



How It Works:

Connect in the cathode line, plug into 115V AC source, set timer, and put MACARR PMC "on" — Insertion of work on cathode rod of any amperage between 2 and 150 will automatically start timer, will time for preset interval. Simultaneously at this point a visible and audible alarm operates; also current to work is automatically reduced to a level where it is not plating or deplating. Removal of work resets PMC and it is ready for next load without the operation or manipulation of any switches.

PMC-150 Model—2-120 second time range with 2A to 150 current rating. Other models available with special time and current ranges.

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Associations and Societies

AMERICAN ELECTROPLATERS' SOCIETY

New England Regional Meeting

On April 22, the twenty-second annual New England Regional Meeting, with New Haven as host branch, will be held at the Hotel Statler-Hilton in Hartford, Conn.

Alexander R. Salmond, educational chairman, will open the technical session at 2:00 p.m. by introducing *Alexander Korbelak*, vice-president of Sel-Rex Corp., Nutley, N. J., whose topic will be, "New Industrial Applications for Precious Metal Coatings." The second speaker, *Ralph E. Pettit*, technical advisor of the Metal Industry Dept., Diversey Corp., Chicago, Ill., has chosen as his topic, "Metal Etching — Functional and Decorative."

During the technical session a special bingo party is to be held for the ladies, under the direction of *Mr. and Mrs. Walter J. Dyber*, with *Bob Boulay* as Master of Ceremonies.

Dining, dancing to the music of *William Glenny's* orchestra, and intriguing entertainment will round out the balance of the program.

Buffalo Branch

The Branch held its first meeting of the new year on January 6, at the Niagara Manor, Buffalo, N. Y., with 30 members and guests in attendance.

President *Harold Shapiro* introduced the guests of the evening: *James Gillone*, Wyandotte Chem. Co.; *Robert Oltarzewski*, Oakite Products, Inc.; *Walter Swanton*, Pfaudler Co.; *Max Domros*, Pfaudler Co.; and *Frank Verbocy*, McKaig & Hatch Co.

John Donaldson, chairman of the membership committee, announced each Buffalo branch member will be contacted by mail and asked to submit the name of at least one new prospective member.

Chuck Fotheringham reported briefly on the success of the Christmas Party held December 3, 1960 and thanked all who attended for their support and especially his committee members, *Mel Stachura* and *Don Stackowiak*.

George Wolf, exhibits chairman of the Technical Societies' Council, Annual Science Fair, announced the fair is to be held in Buffalo, April 18-19-20. Mr. Wolf stated the Branch will be awarded $15.00 for each booth that is secured through efforts of one of our branch members.

Mr. Shapiro was nominated for the 1960-1961 Charles Henry Proctor Memorial Leadership Award. He announced that the nominating committee for 1961-1962 Branch officers will consist of *Eric Sampson, Chuck Fotheringham* and *Jack Martin*.

Rolland Campbell read the proposed by-laws sent to him relative to regional conventions. Several of these proposals met with much criticism from Buffalo branch officers and members and will be dealt with at the proper time.

John Tiebor introduced the speaker of the evening, *Charles G. Bueltman*, manager of Waste Treatment Dept., The Permutit Co., New York. Mr. Bueltman presented an interesting and educational talk, with slides, relative to

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Send for our Free 1961 Catalog and Price List illustrating our complete **NEW** line of aluminum and **ALL TITANIUM** standard stock racks. Engineering analysis of your racking problems **FREE!**

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The Wonder Bar #7225 was named by our customers—job shops—industrials big and small ALL tell us the same story—You can cut and color buff with outstanding performance any structural form of brass—bronze—copper—zinc and aluminum.

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waste treatment of metal finishing solutions. The talk was followed by an informative question and answer period.

Robert C. Eich,
Secretary

Newark Branch

With only a dozen members braving the weather which had almost paralyzed the East on Jan. 20, it was moved and passed that a Newark Branch Manual be sent to *Ezra Blount* to be used in connection with A.E.S. National Educational Committee matters. The secretary was instructed to welcome *Ed Faint* back in the area by letter. There were no elections and Secretary *Don Foulke* was instructed to forward *Michael Sandor's* application on, his application having been acted on at the December meeting.

Acting President *Al Korbelak* then turned the meeting over to Librarian *Cy La Manna* who introduced *Al Martini* of the Sel-Rex Corp., who proceeded to expand his "Timely Topic" into a full technical talk because the scheduled speaker, *Dr. Ed Saubestre*, was unable to get to Newark from New Haven. Al presented "Practical Hints on Gold Plating," covering the cyanide and acid types of gold being used widely presently.

Mr. Korbelak then gave the group the low-down (almost) on his recent trip to Japan via Hawaii. He reported an industrial boom, which was contributing to the rapid expansion of modern plating facilities. The question and answer period was of a somewhat less technical nature.

The meeting finally adjourned at 10:15 p.m., at which time the attendees quickly scurried over crunching snow, buffeted by screaming, arctic winds, to their cars and thence home—voting the meeting a pleasant one in spite of the low attendence.

D. Gardner Foulke,
Secretary

New York Branch

President *Joseph Rembecki* called the meeting of Jan. 27 to order at 8:30 P.M. at the Statler. All the branch officers were present. Following recommendations of the board of managers, a motion made and carried to accept *Peter Figari* and *Wallace G. Spiegler* as members. The new members were dully sworn by President Rembecki.

Librarian *Martin Pollack* took over for "Good and Welfare," and introduced *H. J. Wehrfritz* of the Bacco Chemical Co., who spoke on "Etching of Printed Circuits With Ammonium Persulfate," and *Dr. P. H. Magulies* of the same company, who covered the chemical aspects of the Ammonium Persulfate process.

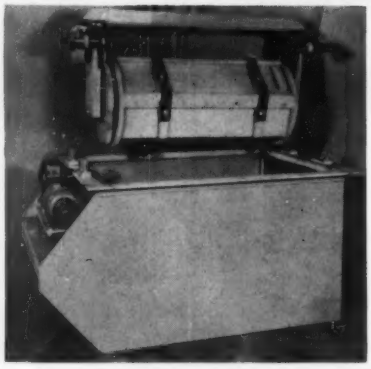
Following the question and answer period both speakers received a round of applause, after which the meeting was adjourned.

Fred Saras,
Recording Secretary

Chicago Branch

The January meeting which was held on Friday, January 13, at Petricca's Restaurant, 510 N. Western Ave., was a joint meeting with members of the Chicago Branch of The Electrochemical Society. An excellent attendance of members from both branches were present for this meeting. *Jack Banta*, president of the Newark branch of the A.E.S., was present at the meeting. *Hal Gilbertson*, a grand old-timer,

PLASTIC PLATING BARREL



New Plating Barrel Designed to Meet the Present and Future Challenges of Plating Problems

Available in any size or style

Constructed of polypropylene, a virtually indestructible plastic, formulated into a one-piece welded unit which can be used safely in any plating solution and at any plating temperature. Tank linings, gears, hangers and cylinders also made of the same plastic.

Your barrel won't have to be taken out of production for unnecessary repairs such as broken or cracked panels, broken rails or door panels.

Write for a *free* sample of polypropylene. Put it through a rough hammer test before deciding to put a polypropylene unit in your production line.

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NEW CONTACT WHEEL with a NATURAL Cushion

A NEW CONTACT WHEEL . . . production tested . . . with natural flexibility that really improves cutting with a least amount of scratch. SAVE extra polishing and buffing operations—less metal loading increases belt life.

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No Obligation!

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MATCHLESS METAL POLISH CO.
ADVANCE POLISHING WHEELS, INC.
840 W. 49TH PLACE — CHICAGO, ILLINOIS
726 BLOOMFIELD, GLEN RIDGE NEW JERSEY

was awarded an honorary membership of the Chicago Branch. *Willard Carter* and *Scott Modjeska* both reported that all the arrangements had been completed for the Annual Banquet.

The speaker of the evening was *John B. Winters*, president and technical director of Incar, Inc., who spoke on "The Anode's Side of the Story." He illustrated his talk with slides and was given a rising vote of thanks after a lively question and answer period.

Christopher Marzano,
Publicity Chairman

Rochester Branch

The January 9th meeting was called to order by President *John Cipollo*. After a short business meeting, the speaker of the evening was introduced by librarian *Loring F. Carson*.

The speaker was *E. J. Kubis* of Wyandotte Chemicals Corp., who gave a talk on "Alkaline Salts and Organic Acids Used in Metal Cleaning."

After the meeting refreshments were served through the courtesy of Wyandotte.

Peter VanDilst,
Secretary

All Day Symposium on Finishing of Light Metals to be Feature of Boston Convention

George Marotta
Technical Co-Chairman

The program for the 48th annual convention of the American Electroplaters' Society to be held at the Hotel Statler, June 19-22, will feature an all day symposium on the finishing of light metals, plant visitations to firms operating unusual and interesting finishing departments, eight other technical sessions, and a fine social program including special features for ladies and children. Included in the social program is a clam bake and a Boston Pops Concert as well as the usual Metal Finishing Suppliers' Association reception. The convention will be concluded with the annual banquet.

The committee suggests that, due to limited accommodations at the Statler Hilton, hotel reservations be made as early as possible.

Syracuse Branch

At 2:30 P.M. on January 18, 52 members of the Branch assembled at the Brown-Lipe Chapin plant in Syracuse for an excellent guided plant tour by Messrs. Corso, Parnell and Simmons, during which the membership was shown and explained the zinc die casting, the stamping, the polishing and the plating operations. For many of the members this was a real opportunity to observe automotive handling and plating of automotive parts in their finest performance. After about a two hours' tour and a short discus-

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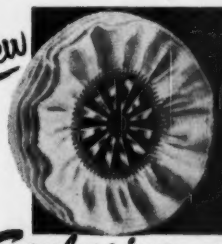
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treatment for Cotton or Sisal Buffs
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Provides firmer buff body • Eliminates loose, frayed fibre ends • Increases buffs ability to hold compound • Makes buffs wear longer and cut harder • Gives better finishing in fewer passes
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Zialite
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The one bath especially designed for plating DIRECTLY on ZINC, LEAD, ALUMINUM, BRASS, COPPER and IRON. "TREMENDOUS THROWING POWER."
for HARD CHROMIUM
USE Zialite ADDITION AGENTS
Harder CRACK FREE deposits. Increased throwing power. Less sensitivity to sulfate content. Exceptionally fine results plating anything calling for Decorative or Hard Chrome.
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sion during the tour, conducted by *Frank Corso*, *Kim Parnell* and *Joe Simmons* of the Brown-Lipe Chapin staff, a very fine dinner was given by the hosts.

After dinner, *Manuel Ben*, a member of the Electrochemistry Department of the Research Division of General Motors and Second Vice-President of the A.E.S., gave a progress report on the latest developments on plating on aluminum.

A very lively and lengthy discussion followed the talk, during which time Honorary Member *Dan Gray*, took a very active part. It should be mentioned here that it was learned during that discussion that Dan Gray actually had been plating since 1900; some 61 years in the plating field.

R. Sonnenfeldt,
Recording Secretary

Rockford Branch

To start the 1961 calendar year off with a record turn-out, President *Harold Ellis* invited interested personnel directors of area industry to the Faust Hotel on January 9th to hear *Robert Giesel*, president of Adolph Plating Co., Chicago, Ill., speak on "Testing Personnel for Plating Room Employment." A very representative number of area personnel managers from leading industry were present. A very lively discussion session covering everything from incentive programs, absenteeism and comparative wage scales followed.

Following the general meeting, President Ellis called a short meeting of all committees involved in the plans for the branch annual to be held at the Faust Hotel on March 11th. Educational Committee Chairman *Robert Campbell* announced the confirmed program for both the morning and afternoon sessions: *Ezra Blount*, editor of *Products Finishing*, will discuss "Surface Treatments Prior to Finishing" and *A. T. Leonard*, past president NAMF will outline "The NAMF's role in Metal Finishing."

The afternoon sessions will again feature the annual workshop on metal finishing problems to be moderated by *Leonard Weeg*, National Lock Co., and the panel will consist of *Art Bartman*, Bell & Howell, Chicago, Ill., *Dick Giesel*, Adolph Plating Co., Chicago, Ill., *Henry Bornitske*, Cutler Hammer, Milwaukee, Wis. and *Chet Borlet*, Grand Rapids Brass, Grand Rapids.

Alexander Alexander,
Publicity Chairman

Waterbury Branch

The Branch held its annual "Sustaining Members Night" on Thursday, January 12, at the Roger Smith Hotel. A large turn-out of members and representatives of many of the sustaining members of the Branch were present. Vice-president *Louis Porretti* opened the meeting.

It was announced that *William Gray* would be the Branch's "Old Timer" to be honored at the "Old Timers' Night," held in conjunction with the Interim Meeting in Hartford on February 11. Mr. Gray is a charter member of the Branch and was branch president during the years 1921-25, 1930 and 1931. He was foreman of finishing at the Waterbury Buckle Co. until he retired in 1940. In 1948 Mr. Gray was elected an Honorary Member of the Branch.

The speaker of the evening was introduced by Technical Chairman *Raymond Mitchell*. *Dr. John O'M. Bockris*, professor of chemistry, University of Pennsylvania, spoke on "Atomic and Ionic Movements in Electrodes." Dr. Bockris gave an excellent presentation covering his work and the many guests had an opportunity to get an insight into the scope and caliber of the work being carried on with their help.

F. A. Schneiders,
Publicity

Dayton Branch

The regular meeting of the Branch was held January 18, at the Biltmore Hotel. Thirty-five members and their guests were present. In the course of the business meeting, *Larry Hadlock* reported on the Tri-State Meeting. *Walter Anderson* proposed a Work Shop Meeting similar to that held by the Mid-Western Group at South Bend. He suggested three panel groups to answer questions on plating, mechanical finishing, and organic finishing. No social functions would be planned. His proposal was enthusiastically received. President *Byron Bowman* reported that *Robert Fisher* had been appointed Branch research chairman and Tri-State regional research finance chairman.

Walter E. Pocock, development engineer of Allied Research Products, Inc. of Baltimore, Md. discussed "Water Soluble Resin Systems as Plating Post Treatments." Color slides were shown which illustrated salt spray resistance and appearance of chromate and resin coatings over various metals, and phosphate and resin coatings over bare steel. A brisk question and answer period was followed by refreshments through the courtesy of Allied Research.

L. A. Critchfield,
Public Relations Chairman

LAZO — The Pioneer for Better Metal Finishing

The LAZO "KING-PIN" . . .
Model 2-SHOMC-2 . . .
Single Barrel . . . Motorized

Size: 14"x30" inside cylinder dimen.
Size: Overall: 50"x20"x32" high
1/8" Standard Perforations
Any Type Parts up to 4" dia.
All Plating Solutions
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1.0-2.8 pH	10.5-13.0 pH
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Second Annual Symposium on Finishing at Phoenix, Arizona

The Phoenix branch of the American Electroplaters' Society will sponsor an all-day meeting on Saturday, March 25th, to be held at the Chemistry Building, Arizona State University, Tempe, Ariz.

The following papers will be presented: "Copper Plating," *Elburn Marcum*, Electro-Chemicals Dept., E. I. du Pont de Nemours & Co.; "Some Aspects of Air Agitated Nickel Plating," *William Lidtke*, L. H. Butcher Co.; "Chrome Plating Up-to-Date," *Gene Combs*, Diamond Alkali Co.; "Defining and Establishing Metal Finishing Quality Standards," *Gene Kirsch*, General Electric Co., Computor Dept.; "Costing and Pricing Metal Finishing Production Jobs," *Willard Bell*, Chemresearch Co.; "Control of Metal Finish Quality," *Jack Beall*, Crown Chemical and Engineering Co.

Registration fee is $5.00 per person, which includes the luncheon.

For further information or registration contact *Joe Motil*, 316 W. 6th St., Mesa, Ariz.

Toronto Branch

Observing its 49th anniversary as a chartered branch of the A.E.S., the Branch will conduct a "Symposium on Metal Finishing" at the Seaway Hotel, Toronto, on Tuesday, March 28. This outstanding technical event will include a morning and afternoon educational program directed to the processing and characteristics of electrodeposited metal finishes, with subjects being presented by international experts. Among speakers already programmed are *Cleveland F. Nixon*, director of electroplating research, General Motors Corp., who is also a past A.E.S. national president; *Clarence H. Sample*, The International Nickel Co. and *Dr. A. Kenneth Graham* of Graham, Crowley and Associates. The meeting's luncheon session will be addressed by a prominent Toronto executive. *H. A. Skelton* is the symposium general chairman.

Tickets, which are being distributed on an advance registration basis, and other information, may be obtained by contacting: *M. S. Green*, Armalite Company Ltd., Postal Station "U", Toronto 18, Ontario. Teelphone — RO. 3-2211.

Registration fee for entire session, including luncheon, is $7.00 per person.

British Columbia Branch

A technical meeting was held at the Loughead Hotel, Thursday, January 19, with 20 members present. President *Gordon Smith* extended a warm welcome to the speaker, Mr. Weekly of Macdermid Pacific, Inc., Torrance, Calif., as well as new member *Irving Klein*, and also to *Bob Lymen*, a previous member reinstated.

Mr. Weekly gave a very interesting and informative talk on plating from cyanide baths, as well as chromate and color dips, and displayed some excellent samples of zinc die-cast and aluminum color finishes.

A most enjoyable discussion and question period followed, and the meeting was closed with a vote of thanks by *Bill Marquardt*.

C. Schlossareck,
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CALENDAR

Mar. 20-24: 12th Western Metal Congress and Exposition, American Society for Metals, Pan-Pacific Auditorium, Los Angeles, Calif.

Mar. 28: First Symposium on Metal Finishing, Toronto Branch A.E.S., Seaway Hotel, Toronto, Ontario, Canada

Apr. 22: 22nd Annual New England Regional Meeting, A.E.S., Hotel Statler, Hartford, Conn.

Apr. 30-May 4: Spring Meeting, The Electrochemical Society, Claypool Hotel, Indianapolis, Ind.

May 5-6: Empire State Regional Annual Meeting, concurrent with Rochester Branch A.E.S. 50th Anniversary Celebration, Hotel Manger, Rochester, N. Y.

May 8-11: 1st International Industrial Finishes Exhibition, Earls Court, London S.W. 5, Eng.

May 27: Annual Banquet, Masters' Electro-Plating Association, Plaza Hotel, New York, N. Y.

June 10: Annual Ladies' Night Dinner Dance, Pittsburgh Branch A.E.S., Churchill Valley Country Club, Pittsburgh, Pa.

June 18-23: 48th Annual Convention, A.E.S., Boston Host Branch, Boston, Mass.

Sept. 5-8: 11th National Chemical Exposition, Chicago Amphitheater, Chicago, Ill.

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Broadway at Seventh, Cincinnati 2, Ohio
Du Pont de Nemours & Co., E. I. 32, 33
Wilmington 98, Del.
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1075 Stewart Ave., Garden City, N. Y.
Dytex Chemical Co.
140 India St., Providence 3, R. I.
Electro-Glo Co. 97
625 S. Kolmar Ave., Chicago 24, Ill.
Enjoy Chemical Co., Div. of Humble Oil & Refining Co. 31
15 W. 51st St., New York 19, N. Y.
Enthone, Inc. 3
442 Elm St., New Haven 8, Conn.
Federated Metals Div., American Smelting & Refining Co. 25
120 Broadway, New York 5, N. Y.
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Formax Mfg. Co. 99
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118 E. 28th St., New York 16, N. Y.
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538-542 Forest St., Kearny, N. J.
H & S Equipment Sales Co., Div. J. Holland & Sons, Inc. 107
Keap St., Brooklyn, N. Y.
Hamilton Emery & Corundum Co. 105
Chester, Mass.
Hammond Machinery Builders, Inc. 89
1601 Douglas Ave., Kalamazoo 54, Mich.
Hammond Solvents Recovery Service 108
241 Brunswick St., Hammond, Ind.
Handy & Harman 88
82 Fulton St., New York 38, N. Y.
Hanson-Van Winkle-Munning Co. 10, 11, 38
Matawan, N. J.
Hardwood Line Mfg. Co. 104
2022 N. California Ave., Chicago 47, Ill.
Harshaw Chemical Co., The 27
1945 E. 97th St., Cleveland 6, Ohio
Heatbath Corp.
Springfield 1, Mass.
Heil Process Equipment Corp. 26
12914 Elmwood Ave., Cleveland 11, Ohio
Hooker Chemical Corp.
1312 Union St., Niagara Falls, N. Y.
Hubbard-Hall Chemical Co., The 75
22 Benedict St., Waterbury 20, Conn.
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Illinois Water Treatment Co. 84
840 Cedar St., Rockford, Ill.
Imperial Industries, Inc.
4436 Walker Ave., Wayne, Mich.
Industrial Filter & Pump Mfg. Co. 22
5906 Ogden Ave., Cicero 50, Ill.
International Nickel Co., Inc. 18
67 Wall St., New York 5, N. Y.
Jelco Finishing Equipment Corp. 34
153 E. 26th St., New York 10, N. Y.
Kelite Corp. 82
81 Industrial Rd., Berkeley Heights, N. J.
Kinney Vacuum Div., The New York Air Brake Co.
3532 Washington St., Boston 30, Mass.
Koch Sons, Inc., George
10 S. 11th Ave., Evansville 4, Ind.
Kocour Company 26
4802 S. St. Louis Ave., Chicago 32, Ill.
Kosmos Electro-Finishing Research, Inc. 36
140 Liberty St., Hackensack, N. J.
Kushner, Dr. Joseph B. 105
621 S. Norman, Evansville 14, Ind.
Laoureux
B.P. No. 2, Deville-Les-Rouen, France
Lasalco, Inc. 35
2820-38 LaSalle St., St. Louis 4, Mo.
Lea Mfg. Co. 19
16 Cherry Ave., Waterbury 20, Conn.
Lea-Michigan, Inc. 98
14459 Wildemere, Detroit 38, Mich.
Lea Products Co. 36A
996 De Boullion St., Montreal 15, Quebec, Can.
Lea-Ronal, Inc. 20
139-20 109th Ave., Jamaica 35, N. Y.
L'Hommedieu & Sons Co., Chas. F. 5
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Lindale Equipment & Supply Corp. 106
504 Smith St., Brooklyn 31, N. Y.
Macarr, Inc. 100
4360 Bullard Ave., Bronx 66, N. Y.
MacDermid, Inc. Back Cover
Waterbury 20, Conn.
Magnus Chemical Co., Inc. 91
11 South Ave., Garwood, N. J.
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Matchless Metal Polish Co., The 102
840 W. 49th Pl., Chicago 9, Ill.
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Metal & Thermit Corp. 36B
Rahway, N. J.
Michigan Buff Co., Inc. 107, 109
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8615 Grinnell Ave., Detroit 13, Mich.
Mitchell-Bradford Chemical Co.
Wampus Lane, Milford, Conn.
Motor Repair & Mfg. Co., The 108
1555 Hamilton Ave., Cleveland 14, Ohio
Munning & Munning, Inc. 86
202-208 Emmett St., Newark 5, N. J.
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P. O. Box 180, Maple Rd. E., Birmingham, Mich.
National Plastics & Plating Supply Co. 34
Box 34, Terryville, Conn.
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Nu-Lite Plating Equipment Co., Inc. 102
777 Meeker Ave., Brooklyn 22, N. Y.
Oakite Products, Inc. 4
18 Rector St., New York 6, N. Y.
Packer Machine Co.
456 Center St., Meriden, Conn.
Parker Rust Proof Co. 12, 13
2167 E. Milwaukee, Detroit 11, Mich.
Pasco Plating Equipment Corp. 107
75 Wythe Ave., Brooklyn 11, N. Y.
Pfizer & Co., Inc., Chas. 29
630 Flushing Ave., Brooklyn 6, N. Y.
Phelps Dodge Refining Corp. 94
300 Park Ave., New York 22, N. Y.
Phillips Manufacturing Co.
3475 W. Touhy Ave., Chicago 45, Ill.
Plating Products, Inc. 96
1509 N. Washington, Kokomo, Ind.
Plating Service & Equipment Corp. 106
1401 Conner, Detroit 15, Mich.
Randolph Products Co. 103
92 North 12th St., Carlstadt, N. J.
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Carrollton, Ohio
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88 Spectacle St., Cranston, R. I.
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